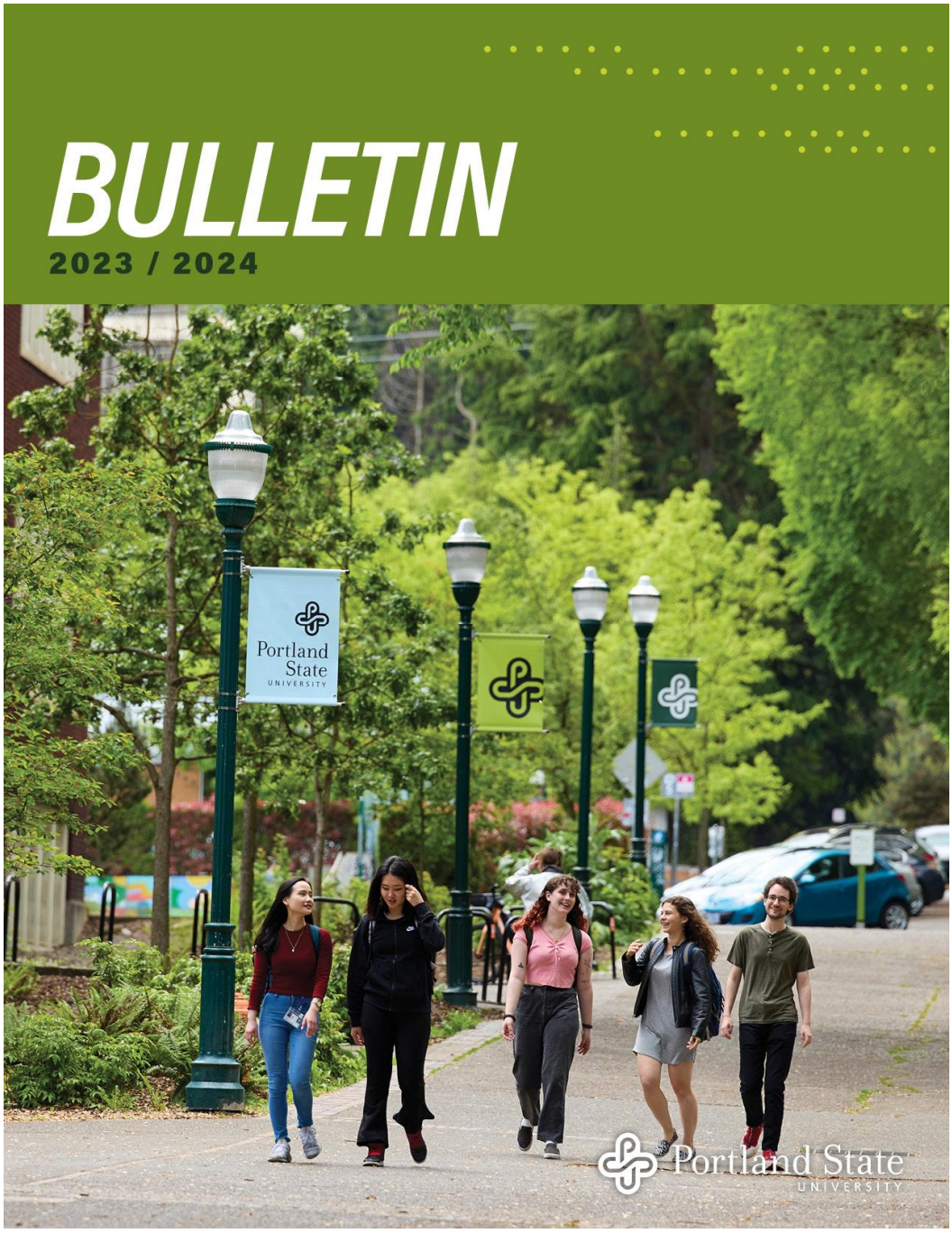
PORTLAND STATE UNIVERSITY

2023-2024 BULLETIN



Information in this *Bulletin* is accurate as of June, 2023. It has been compiled with care but may contain errors. Any errors discovered should be reported to the Office of Academic Affairs.

The *Portland State University Bulletin* is not a contract but rather a guide for the convenience of students. The University reserves the right to change or withdraw courses; to change the fees, rules, and calendar for admission, registration, instruction, and graduation; and to change other regulations affecting the student body, at any time.

Portland State University supports equal opportunity in admissions, education, employment, housing, and use of facilities by prohibiting discrimination in those areas based on age, color, disability, marital status, national origin, race, religion or creed, sex or gender, gender identity or gender expression, sexual orientation, veteran status, or any other basis in law. This policy implements state and federal laws. Inquiries about it should be directed to the Office of Equity and Compliance, 1600 SW 4th Avenue, Suite 830, Portland, OR 97201, 503-725-5919, or via email to equityandcompliance@pdx.edu; TTY: 503-725-6504.

P.O. Box 751
Portland, OR 97207-0751

PSU Admissions: 503-725-3511
PSU Main Line: 503-725-3000
Toll Free: 1-800-547-8887

www.pdx.edu

ACADEMIC CALENDAR

	FALL 2023	WINTER 2024	SPRING 2024	SUMMER 2024	FALL 2024
[1]**Registration begins**	May 8	Oct. 30, 2023	Feb. 12	April 29	May 6
[2]**Classes begin**	Tue. Sept. 26	Jan. 8	April 1	June 24	Sept. 30
Last day to enroll in classes, add a class, or make section changes	Oct. 6	Jan. 19	April 12	varies	Oct. 11
Last day to drop without course recorded as W	Oct. 8	Jan. 21	April 14	varies	Oct. 13
Last day of refund period	Oct. 22	Feb. 4	April 28	varies	Oct. 27
Last day to make changes in grading option	Nov. 12	Feb. 25	May 19	varies	Nov. 17
Last day to withdraw from a class	Nov. 12	Feb. 25	May 19	varies	Nov. 17
Final examinations	Dec. 4-9	March 18-23	June 10-15	varies	Dec. 9-14
Term ends	Dec. 9	March 23	June 15	varies	Dec. 14
[3]**Commencement**			June (dates vary by college)		
Holidays	Nov. 10 Nov. 23-24	Jan. 15	May 27	July 4Sept. 2	Nov. 11 Nov. 28-29

[1] Refer to www.pdx.edu/registration for information on registration dates, deadlines and procedures.
[2] Fall term begins on Tue - September 26 in observance of Yom Kippur.
[3] Refer to www.pdx.edu/commencement for schedule of ceremonies by school and college.

WELCOME TO PORTLAND STATE UNIVERSITY

Vision, Mission and Values

Our vision: Portland State University leads the way to an equitable and sustainable future through expanding opportunity, serving our city, and promoting academic and research excellence.

Our mission:

- We serve and sustain a vibrant urban region through our creativity, collective knowledge and expertise.
- We are dedicated to collaborative learning, innovative research, community engagement, and career preparation.
- We educate a diverse community of lifelong learners.
- Our research and teaching make a global impact.

Our values:

- We promote access, inclusion, and equity as pillars of excellence.
- We commit to curiosity, collaboration, stewardship, and discovery.
- We strive for problem-solving innovation.
- We believe everyone should be treated with integrity and respect.

Engaged with the community

With more than 22,000 students, Portland State University is a nationally recognized leader in community engagement, combining academic rigor in the classroom with community-based learning.

While students from across the country and around the world come to Portland State, close to 80% of students are from Oregon and most will stay in the state after graduation. They choose Portland State because its urban setting and ties to businesses and service organizations make it a living laboratory that prepares tomorrow's leaders with the experience they need to succeed.

Portland State has a national reputation for innovation, community engaged learning and social mobility and it is recognized as a valuable engine for Oregon's economy and its workforce.

Distinguished Programs and Faculty

Many of Portland State's disciplinary programs are nationally ranked in the top 20 in the United States, and the Princeton Review lists PSU among its Best Colleges.

The innovative University Studies program, a four-year general education program which promotes community-based, interdisciplinary learning, and engagement with real-world problems, has established Portland State as a national model for other colleges and universities.

The University Honors College is the only urban-focused honors college in the country. Here, a small, dedicated community of highly motivated students and engaged professors explore an academically intense curriculum through the lens of the culturally rich, ever-evolving city of Portland.

Portland State professors are prized for their knowledge, research and service. Faculty come to Portland State from colleges and universities around the world. Though diverse in culture, background, language, and ethnicity, they come to Portland unified in their commitment to the University's exceptional approach to learning and engagement.

PSU's motto, "Let knowledge serve the city," inspires faculty research. PSU professors research some of society's greatest challenges—providing students with firsthand knowledge and opportunities for involvement and collaboration in their communities. Faculty use their expertise to serve the region through their work with businesses, nonprofits, and governmental agencies and by holding key posts in professional, cultural, and civic groups.

Portland: The community is our campus.

Portland State University's vibrant location in the middle of a major city guarantees students are always steps from excitement and action. Parks, museums, cafes, theaters, shopping, acclaimed restaurants, and professional sports are all easily accessible.

Established in 1946 to meet the educational needs of GIs home from World War II battlefields, Portland State found its first home in Vanport, a former community along the Columbia River. Following the tragic Vanport Flood, the campus moved to Lincoln Hall in Portland's South Park Blocks in 1952 and now stretches across 44 downtown acres, retaining a park-like beauty within its urban setting.

Students and faculty often gather in the Park Blocks to talk or study. PSU's Urban Center is home to the busiest public transportation hub in the city. It's the only location in the city where TriMet's bus system, Portland Streetcar, and the MAX light rail line come together. Hundreds of students get to campus under their own power, commuting by foot or bicycle along Portland's pedestrian and bike-friendly

streets.

With urban sophistication, small-town accessibility, and many outdoor activities, Portland and Portland State offer a great living and learning experience.

Sustainability: It's what we do.

For the last decade, Portland State has maintained a Gold rating in the rigorous Sustainability Tracking, Assessment & Rating System (STARS), standing out for its environmental practices, progress on climate adaptation, and sustainability-focused education.

The Portland State campus itself is a model for sustainability; each new building or major renovation on campus since 2004 has received a Leadership in Energy and Environmental Design (LEED) certification.

Portland State students can take sustainability lessons beyond the classroom, engaging directly with the community and businesses to solve real-world problems and achieve further sustainability at the local and regional levels through internships, co-ops and other opportunities. Portland State strives to harness the strengths of the university to move closer to solving the environmental, social, and economic problems of our time.

Faculty and students perform valuable research and developing solutions to address issues related to homelessness, climate change, public health, and urbanization. Students in departments across campus consider issues that integrate economic, social, and environmental viewpoints. Armed with this knowledge and experience, and a strong sense of ethical leadership, they will lead the next generation in building a more equitable, livable, resilient world.

Research & Graduate Studies

PSU is the region's leading urban research university and offers wide-ranging research opportunities for undergraduate and graduate students who aspire to be explorers, innovators, problem-solvers, and change-makers.

Our faculty includes internationally recognized researchers in engineering and physical, natural and social sciences, as well as the arts and humanities. PSU researchers are making vital contributions in fields ranging from climate science to the development of new treatments for diseases and the search for life beyond Earth. Our research strengths in specialized fields such as early childhood learning and biochemistry attract world-class partners like the Howard Hughes Medical Institute. And programs like NIH-funded Build EXITO provide students with access to cutting-edge research as well as training and professional development opportunities. Opportunities to explore entrepreneurship and commercialization of student and faculty intellectual property are provided through Propel PSU's Center for Entrepreneurship, Innovation and Intellectual Property, and the Portland State Business Accelerator.

Researchers at PSU work across disciplines and partner with industry, government agencies, nonprofit organizations, and other universities to address the critical challenges of the 21st century and improve life in Oregon, the nation, and the world. We collaborate with Oregon Health & Science University through the OHSU-PSU School of Public Health and interdisciplinary research where our expertise in data analysis, social science, biology, and chemistry add value to OHSU's clinical studies. Our University Research Centers work to improve urban life by evaluating "smart city" technologies, exploring solutions to complex issues such as homelessness, and improving transportation. At PSU, we bring the future into focus.

The Founding of Portland State University

Portland State University's roots trace back to the summer of 1946 when the Oregon State Board of Higher Education approved the opening of a temporary school in North Portland to offer lower-division coursework. Vanport Extension Center (VEC), named for its location between Portland and Vancouver, was situated in Vanport City, a wartime housing project that promised resident and classroom space for the students attending VEC. Spearheaded by founder and director, Stephen Epler, VEC soon became known as "Vanport College" and was immediately successful in meeting local demands for higher education by returning World War II servicemen and women. When fall term registration closed at VEC, more than 1,400 students enrolled, eclipsing the projection of 500 and signaling future success for the center.

Seemingly ending VEC's future, the 1948 Memorial Day flood of the Columbia River destroyed Vanport City, including the center. Epler and his colleagues kept the school alive, using federal funds to reinstate the campus at "Oregon Ship," a former Oregon Shipbuilding Corporation site. The school's commitment and fighting spirit earned it the national reputation as "the college that would not die." Students, faculty, community groups, and legislators were strong advocates for the school, spurring its permanence and move in 1952 to its present location in Portland's South Park Blocks, where it became the Portland State Extension Center in the former Lincoln High School (now Lincoln Hall).

In 1955, the legislature created Portland State College as a four-year degree-granting institution. Graduate work was added in 1961; doctoral programs began in 1968, and the institution became Portland State University in 1969. The University has grown from an initial enrollment of 1,410 students in 1946 to become one of Oregon's largest universities.

"Portland State formed a legacy of courage, leadership, dedication, and collaboration during its founding years, 1946-1955. These qualities enabled a small extension center to become a four-year, degree-granting college. Today this legacy inspires Portland State University to enhance the intellectual, social, cultural, and economic vitality of Portland, the Pacific Northwest, and beyond."[1]

The Founder and presidents who have served the University are:

- Stephen E. Epler (Vanport Extension Center), 1946 to 1952;
- John F. Cramer, 1955 to 1958;
- Branford P. Millar, 1959 to 1968;
- Gregory B. Wolfe, 1968 to 1974;
- Joseph C. Blumel, 1974 to 1986;
- Natale A. Sicuro, 1986 to 1988;
- Roger N. Edgington (interim president), 1988 to 1990;
- Judith A. Ramaley, 1990 to 1997;
- Daniel O. Bernstine, 1997 to 2007;
- Michael F. Reardon (interim president), 2007 to 2008;
- Wim Wiewel, 2008 to 2017;
- Rahmat Shoureshi, 2017 to 2019
- Stephen Percy, (interim president 2019 to 2020) appointed president 2020 to 2023; and
- Ann E. Cudd, 2023 to present.

[1]From Creating Portland State: 1946-1955.

Accreditation

Portland State University is accredited by the Northwest Commission on Colleges and Universities.

Accreditation of an institution of higher education by the Northwest Commission on Colleges and Universities indicates that it meets or exceeds criteria for the assessment of institutional quality evaluated through a peer review process. An accredited college or university is one which has available the necessary resources to achieve its stated purposes through appropriate educational programs, is substantially doing so, and gives reasonable evidence that it will continue to do so in the foreseeable future. Institutional integrity is also addressed through accreditation.

Accreditation by the Northwest Commission on Colleges and Universities is not partial but applies to the institution as a whole. As such, it is not a guarantee of every course or program offered, or the competence of individual graduates. Rather, it provides reasonable assurance about the quality of opportunities available to students who attend the institution.

Inquiries regarding an institution's accredited status by the Northwest Commission on Colleges and Universities should be directed to the administrative staff of the institution. Individuals may also contact:

Northwest Commission on College and Universities
8060 165th Avenue N.E., Suite 100
Redmond, WA 98052
(425) 558-4224
www.nwccu.org

In the College of Liberal Arts & Sciences; the Department of Speech and Hearing Sciences is accredited by the Council on Academic Accreditation (CAA) of the American Speech-Language Hearing Association (ASHA). The Department of Chemistry is accredited by the American Chemical Society (ACS).

In the College of the Arts; the School of Music & Theater's bachelor's and master's programs are accredited by the National Association of Schools of Music (NASM). Theater programs are accredited by the National Association of Schools of Theater (NAST). The Master of Architecture degree in the School of Architecture is accredited by the National Architectural Accrediting Board (NAAB).

In the College of Urban and Public Affairs; the Master of Urban and Regional Planning degree is accredited by the Planning Accreditation Board (PAB). The Master of Public Administration and the Executive Master of Public Administration are accredited by the Network of Schools of Public Policy, Affairs and Administration (NASPAA). The Master of Public Administration – Health Administration is accredited by the Network of Schools of Public Policy, Affairs and Administration (NASPAA).

In the College of Education; the P-12 educator preparation programs underwent both state and national accreditation review in 2023 through Oregon's Teacher Standards and Practices Commission (TSPC) and Association for Advancing Quality in Educator Preparation (AAQEP), and are accredited for seven years with a follow-up visit scheduled for 2030. The counseling programs are accredited by the Council for Accreditation of Counseling and Related Educational Programs (CACREP). The Helen Gordon Child Development Center is accredited by the

National Association for Education of Young Children (NAEYC).

In the Maseeh College of Engineering and Computer Science, the undergraduate engineering and computer science degrees are accredited as follows: Bachelor of Science (Civil Engineering) - accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Civil and Similarly Named Engineering Program Criteria. Bachelor of Science (Environmental Engineering) - accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Environmental Engineering and Similarly Named Engineering Program Criteria. Bachelor of Science (Computer Science) - accredited by the Computing Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Computer Science and Similarly Named Computing Program Criteria. Bachelor of Science (Electrical Engineering) - accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Program Criteria. Bachelor of Science (Computer Engineering) - accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Program Criteria. Bachelor of Science (Mechanical Engineering) - accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Mechanical and Similarly Named Engineering Program Criteria.

In the School of Business; the undergraduate and graduate business programs as well as the accounting program are accredited by The Association to Advance Collegiate Schools of Business International (AACSB).

In the School of Public Health; the undergraduate programs in Applied Health and Fitness, and Public Health Studies, the Master of Public Health degrees, the Master of Science in Biostatistics, and the Ph.D. programs in Community Health, Epidemiology, Health Systems and Policy are all accredited by the Council on Education for Public Health (CEPH). The Health Management & Policy MPH is also accredited by the Commission on Accreditation of Healthcare Management Education (CAHME).

In the School of Social Work; both the bachelor's and the master's programs are accredited by the Council on Social Work Education (CSWE). The Child, Youth, & Family Studies certificate program is accredited by the National Council on Family Relations (NCRF).

ADMISSIONS REQUIREMENTS

U.S. Citizens and Immigrants (Domestic Undergraduate Applicants)

Application

Domestic students must submit the following information to the Office of Admissions.

1. Application submission and nonrefundable fee. Students should apply at www.pdx.edu/admissions/apply-psu via the PSU Application, Common Application, or Coalition Application. To ensure consideration for admission, students should submit their application by the established deadline for their intended start term and submit the nonrefundable $60 application fee (fees subject to change without notice) when applicable. The application and nonrefundable $60 fee are valid for three terms from the first admission term.

2. Admission validation. To validate admission, the student must register for classes and enroll during their intended term of admission as selected on their application. If the student does not register and enroll for their first term, the application may be updated to one of the next three consecutive terms without repaying the application fee; applicants will not be updated automatically. After this update period, applicants must submit a new application along with another $60 application fee.

3. Official transcripts. Transcripts must be submitted directly by each high school or college attended. Transfer students who have earned fewer than 30 quarter credits of transferable college coursework are also required to submit official high school transcripts. In addition, all applicants who graduated from an Oregon high school in 1997 or after will be required to submit a high school transcript to validate their Second Language graduation requirement if it was met in high school.

To be considered "official," transcripts must be received by PSU in the sealed (unopened) original envelope or through approved electronic means from the issuing school. Since all official transcripts submitted become the property of PSU and cannot be copied, returned to the student, or shared with other institutions, students are encouraged to obtain unofficial copies of their transcripts from prior institutions for advising or personal purposes.

4. SAT or ACT scores (Optional). Applicants who satisfy Portland State's minimum curriculum and GPA requirements are not required to submit test scores. ACT and SAT scores submitted by students who are admissible based on GPA and high school curriculum will only be considered as "value added" in the admission process.

NOTE: Applicants who attended homeschool, or a non-accredited, non-standard high school, are required to submit test scores. In order for scores to be considered "official," reports must be sent directly from the respective testing agencies to Portland State University.

SAT School Code is 4610

ACT School Code is 3492

Important: Altered transcripts and falsified applications.

Students who knowingly submit altered transcripts or falsified applications jeopardize their admission status and may have their admission rescinded and/or their registration canceled; in some cases, future application opportunities may also be denied. These penalties may also apply in cases in which transcripts are knowingly unreported to or withheld from Portland State University.

Admissions Professional Conduct Policy
Meeting Portland State University's minimum admissions requirements alone does not guarantee admission to the University. PSU may evaluate an applicant's behavior and background throughout the application process to determine their ability to adhere to the University's academic and professional conduct standards. This evaluation may take into consideration current behavior and performance as well as past experiences and actions in the context of an application for admission.

All records submitted, filed, and accumulated in the Office of Admissions become the property of the University. The number of students admitted for any term is subject to the availability of space. When space is limited, selection may be based on grade point average, date of application, intended major, test scores, etc.

Admission Requirements—Entering Freshmen (First Years)

To be admitted as freshmen, applicants need to fulfill each of the requirements (or alternatives) as specified in all of items 1-4 below.

1. High school graduation requirement. Applicants must have graduated from a standard or regionally accredited high school. Students who have not graduated from a standard or regionally accredited high school may meet entry requirements through alternative testing. Alternative testing includes successful completion of one of the following:

• Test of General Education Development (GED):

• Applicants with an overall average GED score of 151 or above on the latest form of the GED exam will be considered holistically for admission to PSU. Takers of prior forms of the exam will need to achieve scores listed below.

• If you took the GED between January 1, 2002 and December 31, 2013: earn a minimum overall average score of 580 and a minimum score of 410 on each subject test

• If you took the GED prior to January 1, 2002: earn an overall average score of 46 and a minimum score of 40 on each subject test

• HiSET®

• Minimum score of 15 on each subject test area and a 4/6 on the essay component of the Language Arts-Writing subject test

• TASC®

• Minimum score of 580 on Language Arts-Reading, 560 on Mathematics, 560 on Language Arts-Writing, and at least 6/8 on the Language Arts-Writing essay.

Non-accredited or non-standard high school graduates:

Students from non-accredited or non-standard high schools, or home-school students, may meet the high school graduation requirement with a minimum score of 1120 or higher on the combined Writing & Language and math portions of the SAT, or with a composite score of 22 on the ACT®.

2. High School Subject requirements. Resident applicants must satisfactorily (grade of C- or above) complete at least 15 units (one year equal to one unit) of college preparatory work in the following areas, while non-resident applicants must satisfactorily (grade of C- or above) complete at least 13 units (one year equal to one unit):

• a. Language Arts (4 units). Students must have the equivalent of 4 years of courses that focus on writing, rhetoric, literary analysis, and critical reading with emphasis on and frequent practice in writing a variety of genres during all four years. PSU accepts language arts courses for coursework taught in languages other than English. Such courses will count toward our language arts course requirement so long as they focus on the criteria above. Note that most coursework at PSU is taught in English. Applicants who earn the Oregon State Seal of Biliteracy certification will satisfy PSU's Language Arts course requirement.

• b. Mathematics (3 units). Must include first-year algebra and should include two additional years of college preparatory mathematics (with the final year equivalent to or greater than the level of Algebra II) selected from geometry (deductive or descriptive); advanced topics in algebra (through Algebra II), trigonometry, analytical geometry, finite mathematics, advanced applications, calculus, and probability and statistics, or courses that integrate topics from two or more of these areas. One unit of math is strongly recommended in the senior year. (Algebra and geometry taken prior to ninth grade will be accepted if posted on HS transcript.)

• c. Science (3 units). Must include at least a year in fields of inquiry based college preparatory science such as biology, chemistry, physics, or earth and physical science. Science courses that are "inquiry based" provide students the opportunity to apply scientific reasoning and critical thinking to support conclusions or explanations with evidence from their investigations. It is strongly recommended that one year be taken as a laboratory science and that a total of three years of science be taken. Applicants with 2 years of science coursework will not be denied based on admission requirements, but may be admitted with a deficiency in coursework.

• d. Social Studies (3 units). Must include analysis of societal issues and events. It is strongly recommended that study includes knowledge and use of geographic information, patterns of United States history, patterns of human history, structures and systems of the US Government, and analysis of economic systems.

• e. Second Language (2 units). Must include demonstrated proficiency equivalent to two years of the same high school-level second language. This requirement applies to anyone who graduated from an Oregon high school in 1997 or any year after. Students may demonstrate proficiency by meeting one of the following options:

High School and College Options

• Pass with a C- or better, two years of the same high school-level second language

• Pass with a C- or better, the third year of a high school-level second language

• Pass with a D- or better two quarters or two semesters of college-level second language

Second Language Proficiency-based Assessment Options

• Score of 2 or higher on an Advanced Placement Foreign Language Test

• Score of 4 or higher on an International Baccalaureate Standard Level Foreign Language Exam

• Score of 40 or higher on a CLEP Foreign Language Exam

• Score of 500 or higher on an SAT Foreign Language Subject Test if taken in July 2021 or earlier

• Education satisfactorily completed through 7th grade in a school or country where English was not the language of instruction

• Satisfactory performance (P) on a Brigham Young Foreign Language Assessment (BYU FLATS)

• Score of novice-high or higher on the Standards-based Measurement of Proficiency (STAMP)

• Score of 226 or higher on a Proctored WebCAPE (only offered in Spanish for the Second Language Admission requirement)

• Score of novice-high or higher on the ACTFL scale in American Sign Language (ASL)

• Score of novice-high or higher on a ACTFL Oral Proficiency Interview

• Credit for Prior Learning

**American Sign Language qualifies as a second language.

Students failing to meet the Second Language Proficiency requirement at the time of admission may be admitted, but will not be able to earn an undergraduate degree at Portland State University until the second language requirement has been completed. Students must provide official high school or college transcripts to demonstrate the Second Language Proficiency Requirement has been met.

Alternatives to the subject requirements if no standard high school diploma is awarded. (Any one of the following.)

Score an average of 470 or above (1410 total) on the SAT II subject exams (English Composition, Math Level I or IIc, and a third test of the student's choice) if taken before July 2021.

Score 1120 on the combined SAT Math and Verbal reasoning sections.
Score 22 on the ACT Composite.
Take make-up coursework for specific subject requirements missed in high school and achieve a passing grade. Note: Satisfactory completion of Math 95 or its equivalent (Intermediate Algebra) fulfills in total the subject requirement in mathematics. Take make-up coursework for specific subject requirements missed in high school and achieve a passing grade. Note: Satisfactory completion of Math 95 or its equivalent (Intermediate Algebra) fulfills in total the subject requirement in mathematics.

3. Grade point average requirement. High school students with a cumulative unweighted grade point average of at least 3.00 in all graded subjects taken toward high school graduation. Students who do not meet the 3.00 GPA requirement may be admitted based on holistic review.

NOTE: Beginning with the 2020-2021 academic year Portland State University changed its minimum admission high school GPA requirement for First Year applicants to a 2.5 GPA or higher for regular admission, with applicants who did not meet a 2.5 GPA eligible for holistic review. This requirement adjustment may be extended or may end at the discretion of the University Faculty Senate. The current status of this temporary adjustment will be found at www.pdx.edu/admissions/first-year.

Admission Requirements—Transfer Students

To be admitted as a transfer student, applicants must have a minimum GPA of 2.25 in 30 transferable quarter credit hours of college work. Applicants who present a transferable associate's degree or an Oregon Transfer Module (OTM) will be admitted with a minimum cumulative transferable GPA of 2.00. Students who have accumulated fewer than 30 transferable credits of college work must also meet the freshman admission requirements.

1. Writing proficiency requirement. To be admitted as a transfer student, applicants must satisfactorily complete a writing course satisfying one of the University's writing requirements (e.g. Wr 121Z) or its approved equivalent with a C- or better.

2. Second language proficiency requirement. All resident applicants must meet the second language proficiency requirement described in 2e of the Freshman Admission Requirements section (p. 4).

3. Academic probation/disqualification from other institutions. Academic probation/disqualification will not affect the admissibility of a student whose complete academic record meets the minimum admission requirements in effect at the time of application.

4. Disciplinary disqualification. A student who has been disqualified from another institution for disciplinary reasons must be eligible to re-enroll at that institution to be considered for admission to Portland State University. Students with extenuating circumstances may petition for a waiver of this policy. Other offices on campus may be consulted in evaluating requests for waivers.

After review of circumstances, Portland State University may, for example, ask that you attend a different institution and reapply; decline to accept your application now or in the future; apply other possible conditions or restrictions to your application review.

More information on transferring to PSU is available at www.pdx.edu/admissions/transfer.

International Students

Application

Undergraduate International Students

Application

Applicants who are not U.S. citizens who are currently overseas or reside in the U.S. on non-immigrant visas are considered for admission as international students. Applications will be considered for all terms subject to department and/or University restrictions and/or course availability.

International Undergraduate applicants should submit the following information to the Office of International Undergraduate Admissions. All documents submitted become the property of PSU and cannot be photocopied, returned, or forwarded to third parties.

1. Application submission and $60 nonrefundable application fee. Students should apply at www.pdx.edu/admissions or via the Common Application online. To ensure consideration for admission, students should submit their application by the established deadline for their intended start term and submit the nonrefundable $60 application fee (fees subject to change without notice) when applicable. The application and nonrefundable application fee are valid for one academic year only. The $60 fee cannot be waived.

2. Official transcripts. To be considered official, transcripts must arrive in the Office of International Admissions in a sealed envelope from the issuing school. Applicants whose admission will be based on high school/secondary school graduation should submit official transcripts of their final four years of high school/secondary school study or documentation as requested by the office of Undergraduate International Admissions. Transfer students must submit official transcripts from each college or university attended, regardless of whether or not they feel their prior academic study may be relevant to their PSU study. Transfer students with fewer than 30 quarter credits of college/university coursework are also required to submit transcripts from their final four years of high school/secondary school. Credits from accredited schools outside the U.S. will be transferred to PSU according to established international transfer credit guidelines and policies. See Academic Credit section of this Bulletin for more information. Students who knowingly submit altered or falsified academic records or other application documents jeopardize their admission status and may have their admission rescinded and/or registration canceled.

3. Proof of English language proficiency if seeking direct admission to academic coursework.

4. Evidence of adequate financial resources for educational and living expenses. (International applicants residing in the United States on visas other than F-1 or J-1 student visas may not be required to submit proof of financial resources.)

5. Proof of current immigration status (if already residing in the United States).

6. Admission validation. To validate admission, the student must register for classes during the initial term of admission. If the student does not register for this term, the application start term can be changed to one of the next three consecutive terms without repaying the application fee. After this time period, the student must submit a new application along with another $60 application fee.

Admission Requirements for International Students

Applicants must demonstrate an appropriate level of academic preparation.

First Year: Completion of U.S. academic (university preparatory) high school or secondary school equivalent as determined by the Office of Undergraduate International Admissions with a minimum equivalent 2.50 GPA.
Transfer: Completion of 30 transferable college quarter credits, excluding ESL courses, with a 2.25 GPA or higher at a U.S. regionally accredited college/university or foreign equivalent as determined by the Office of International Admissions. Transfer students who present a transferable associate's degree (AS or AA or an Oregon Transfer Module (OTM) will be admitted with a minimum cumulative 2.00 GPA.

English language proficiency requirement. Admitted students who meet the English language proficiency requirement may enroll directly into academic classes. Those who do not meet this requirement will be placed in ESL classes until the requirement has been met. Applicants may demonstrate English language proficiency by submitting qualifying TOEFL, IELTS, or PTE scores. See minimum qualifying scores below.
English language proficiency requirements may be found at: www.pdx.edu/admissions/international/english-language-proficiency.
Information on the international TOEFL is available at www.ets.org/toefl.

Intensive English Language Program

Persons seeking English language training only, who do not wish to continue toward university-level academic study, may apply for admission to the Intensive English Language Program (IELP). However, persons who want to

study English before beginning academic study are eligible for conditional undergraduate or postbaccalaureate admission without minimum English language proficiency test scores.

The IELP provides both credit and non-credit classes. Students must have earned the equivalent to a U.S. high school diploma for admission consideration. Prospective students must be in legal U.S. immigration status at the time of application.

Contact the Intensive English Language Program, 503-725-4088 or www.pdx.edu/english-language-programs, for additional IELP requirements.

Admission to Professional Programs and Schools

Admission to Portland State University does not automatically admit students to its professional programs and schools. Standards for admission and evaluation of transfer credits often exceed general University requirements. Students should check this catalog under the appropriate academic unit to determine if a unit has special admission requirements.

Student Orientation Programs

503-725-5511
www.pdx.edu/admissions/orientation

Enrollment Management coordinates orientation programs for all undergraduate students new to PSU. All newly admitted undergraduate students are required to attend a new student orientation session before registering for courses.

After admission to PSU, each undergraduate student must complete orientation programming before their start term. In-person and online programming is available. To sign up for New Student Orientation, the student must have already submitted their enrollment confirmation or deposit of $200.

Orientation provides students with the opportunity to meet with current PSU faculty, professional staff, and students in order to:
• Understand academic requirements of a baccalaureate degree
• Successfully develop an academic plan and register for courses
• Access programs and services available to PSU students
• Facilitate the academic and social transition to the University community

Viking Days takes place prior to the start of fall term. This is a week of activities, information sessions, open houses, and social events in which new students are invited to attend and encouraged to participate. For further information, visit www.pdx.edu/viking-days.

ACADEMIC RECORDS, CREDIT, AND APPEALS

Student Records

The University Student Records Policy, in accordance with the federal Family Educational Rights and Privacy Act of 1974 as Amended, governs the collection, use, and disclosure of student records with the goal of ensuring their privacy. Generally it provides the right to non-release of confidential information except as directed by the student, or as provided by law; the right to inspect educational records maintained by the University; the right to correction of errors, a hearing if necessary, and the right to file a complaint with the U.S. Department of Education. Learn more about student records privacy online at www.pdx.edu/registration/student-records-privacy-policy.

Documents Submitted to the University

All documents, including transcripts, submitted to PSU become the property of the University and are not intended for duplication or return to the student.

Academic Record Sealed After Degree Earned

Portland State University academic records are sealed thirty days after the conferral of a degree. After this date, changes to majors and minors, addition of departmental honors, removal of incomplete grades, grade changes, changes to degree posting, or other changes to an academic record cannot be made except by decision of the Scholastic Standards Committee or the Graduate Council.

Academic Credit

Academic Credit Hour Policy

This credit hour definition is based on the traditional Carnegie unit and aligns with the Federal financial aid definition mandated by the United States Department of Education's (USDE) regulations [34 CFR 600.02 and 668.8, effective July 1, 2020] and the Northwest Commission on Colleges and Universities (NWCCU) standards and policies.

As the basic unit of measurement of educational accomplishment the credit hour is used to measure student progress toward a degree, which in turn enables PSU's programs to be eligible for Title IV Financial Aid programs under the Higher Education Act.

These definitions rely on the '50-minute' credit hour when considering in-class meeting times. The PSU standard class scheduling time grid provides sufficient in-class time for both 3 and 4 credit classes.

PSU Definition:

The credit hour is conceptually framed as an amount of student work (i.e. a reasonable approximation of the total time commitment required of the typical student) associated with achieving intended learning outcomes. Under PSU's quarter system, one academic credit is given for a minimum of 30 hours of student work over the term (i.e. a 1:30 ratio over the term). If the course meets regularly for 10 weeks, then 1 credit would require a minimum of 3 hours of student time per week for the 10 week term (i.e. a 1:3 ratio per week for 10 weeks).

- For a standard lecture/seminar class section with synchronous meetings, a minimum of 1 hour of classroom or direct faculty instruction and a minimum of 2 hours of out-of-class student work is required per week for a 10 week instructional term (1:3), or an equivalent amount of work distributed over a different time period (1:30).
- For other credit-bearing activities - such as labs, internships, practica, studio work, projects, mentor sessions - 1 credit requires at least an equivalent amount of student work spread out over the term (i.e. 1:30 ratio).

  Important Note: The policy sets the minimum level of student work/time required per credit, not an upper limit. The standards for the amount of student work per credit can vary greatly by academic unit. Each academic unit determines the structure of such courses and the credit hour ratio, based on variations in commonly accepted disciplinary and accreditation standards/practice within postsecondary education.

Student work includes time spent in:

- Direct Instruction, where the core/primary course content is delivered, typically by faculty during synchronous class meetings, but also includes guided learning through core material via asynchronous online delivery,
- Outside of Class study time, reading assignments, homework, papers, group work, exam preparation, etc., and
  Other Academic Activities which include credit and non-credit bearing course sections designed to review, discuss, practice or apply the course (and program) concepts delivered via direct instruction. Other Academic Activities include the following course types: laboratory, internships, practica, studio, projects,

and other supplemental support sections like mentored inquiry.

Alternative Delivery Formats - Hybrid, Online - No Scheduled Meetings, Partial Term

Classes that do not use synchronous meeting/contact times (for example, hybrid or asynchronous online courses) - or only meet for a partial term (i.e. for fewer than the standard 10 weeks) - will meet the credit hour standard if the course content and outcomes cover the same material in the same depth as a standard 10-week synchronous version of the same course, and the amount of student work is the same. Regardless of the length of the course or the amount of time spent in synchronous learning, the course learning outcomes, subject matter/content covered, and amount of student work must be equivalent to the amount of work/learning associated with the standard 10-week course.

Transferring Credit Hours

PSU is on the quarter-system calendar and all credit hours listed in the PSU Bulletin and schedule of classes refer to quarter credits. Semester credits transferred to PSU from other accredited United States schools may be converted to PSU's credits by multiplying by 1.5 (e.g., 3 semester hours x 1.5 = 4.5 quarter credits). The 1.5 multiplication rule applies only to semester credits transferred from regionally accredited U.S. schools. Credits transferred from accredited schools outside the United States will be converted according to established international transfer credit guidelines and policies. PSU credits transferred out to a semester system institution may be converted by multiplying the number of quarter credits by .67 to determine the semester hour equivalent (e.g., 4 quarter credits x .67 = 2.68 semester credits).

NWCCU Considerations

In accordance with the NWCCU policy, PSU faculty will determine the amount of work associated with a credit hour, by considering learning outcomes and by accounting for a variety of delivery methods, measurements of student work, academic calendars, disciplines, degree levels, and commonly established standards/practices within postsecondary education.

PSU periodically reviews the application of its policy on credit hours across the institution to assure that credit hour assignments are accurate, fair, equitable and reliable across degree levels, academic disciplines, delivery modes, and types of academic activities.

Academic Credit Overload

Undergraduate Academic Credit Overload

Undergraduate students who enroll in more than 21 credits per term are considered to be in academic overload. PSU audit credits and transfer credit taken at other institutions while concurrently enrolled at PSU are counted in determining overload status. **Transfer credits that result in an overload for a given term will not be accepted in transfer unless prior approval has been granted.**

Academic overload must be approved on a term-by-term basis as follows:

- 22-25 credits: Students must obtain prior approval from their academic program adviser using the Overload Approval Form, to be submitted to the Office of the Registrar in advance of the overload term.
- 26 or more credits: Students must obtain prior permission from the Academic Requirements Committee (ARC) by submitting an ARC petition in advance of the overload term. Students must provide justification for the overload and obtain written support from their academic program adviser. Petitions must be submitted using the Academic Requirements Committee petition prior to the first day of the overload term.

Graduate Academic Credit Overload

Graduate students must obtain approval for registration in excess of 16 credits (graduate and undergraduate credits combined) via the Overload Approval form. A student registering for 17 to 19 credits must obtain the approval from their department chair or faculty adviser. A student registering for 20 credits or more must obtain the approval of their department chair and the Graduate School. A graduate assistant registering for more than 16 credits must obtain approval from their department chair and the Graduate School.
Computer Science and Electrical & Computer Engineering graduate students have a lower maximum registration limit of 10 credits. These students must obtain approval to register for 11 or more credits via the Overload Approval form.

Class standing

Class standing is based on the number of credits a student has completed, according to the following schedule:

Class Standing	Credits Completed
Freshman	1-44
Sophomore	45-89
Upper-division standing	90 or more
Junior	90-134
Senior	135 or more

Postbaccalaureate	Hold an undergraduate degree from an accredited college or university

Appeals and Grievances

Grievances and requests for exceptions to University policies and requirements may be filed with specific committees authorized to deal with specific student concerns.

Academic Appeals Board

This board hears appeals from students who claim to have received prejudiced or capricious academic evaluation and makes recommendations on cases to the Provost. In such cases the student should first consult with the instructor. If the grievance is not resolved, the student should then contact the department chair, then the dean of the college or school. If the grievance is still not resolved, the student may then appeal by writing a letter to the Academic Appeals Board. Appeals may be filed in the Office of Dean of Student Life, 433 Smith Memorial Student Union.

Academic Requirements Committee (ARC)

The ARC is a subcommittee of the PSU Faculty Senate and is responsible for developing policies and adjudicating petitions regarding academic regulations related to credit loads, transfer credit, degree and certificate requirements for all undergraduate programs. It also develops and recommends policies and adjudicates student petitions regarding initial undergraduate admissions, including entering freshmen. The ARC Petition process is managed by an online process accessed at www.pdx.edu.registration/academic-requirements-committee-petitions.

Deadline Appeals Committee (DAC)

A student may petition this committee to be exempted from published registration deadlines for the current term when mitigating circumstances prevent deadline compliance. Petitions must include documentation of the reason for missing the deadline.

The petition may be accessed at www.pdx.edu/registration/dac.

For further information students may call 503-725-3220.

Scholastic Standards Committee (SSC)

The SSC is a Faculty Senate committee charged with developing and recommending academic standards to maintain the integrity of the undergraduate program and academic transcripts of the University; developing, maintaining and implementing protocols regarding academic changes to the undergraduate transcript; reviewing and ruling on petitions for any retroactive change to the academic record such as a grade option change, drop, add, and extension of an incomplete beyond the one year deadline; and adjudicating student petitions for academic reinstatement to the University. Conferral of an accredited transferable Associate's or Bachelor's degree constitutes automatic reinstatement to the University once an official copy of a transcript with degree posted is presented to the Office of the Registrar. Petition forms to make retroactive changes to undergraduate academic record, or to seek reinstatement to the University may be obtained at www.pdx.edu/registration/petitions. Forms may also be obtained at the Registrar's Office, FMH Lobby. For further information call 503-725-3220.

ENROLLMENT

Enrollment Process

Registration

Students who have been formally admitted or who have filed a Non-Degree Entry form may register for classes online at my.pdx.edu during the preregistration period for a given term. Registration dates are determined by student class level and admissions status and are listed in the academic calendar under priority registration at www.pdx.edu/registration/academic-calendar. A current, detailed listing of term course offerings can be found in the online Class Schedule at www.sa.pdx.edu/soc. Detailed instructions for registration, priority registration dates, drop and add deadlines and academic calendar can be found online at www.pdx.edu/registration. The class schedule is available approximately eight weeks before the beginning of classes for winter and spring, and available in May for the following fall term.

The academic calendar contains deadlines related to adding and dropping classes, making grade changes, withdrawing from classes, and refund percentages. These deadline dates are important as they determine the extent of financial obligation incurred by registration activity and they determine if and how a course registration will be recorded on a student's transcript. Students who withdraw or drop may be entitled to certain refunds of fees paid. See the Academic Calendar at www.pdx.edu/registration/academic-calendar.

Non-attendance

Students are responsible for dropping courses they do not wish to attend. Non-attendance does not cancel tuition charges, nor does it prevent the course and grade from appearing on the student's academic record. The University reserves the right to drop students who do not attend classes or do not have the proper prerequisites. Some academic departments administratively drop student who not not attend class on the first class meeting. If this happens, the student 1) remains responsible for any tuition charges associated with the registration, and 2) the course may be recorded permanently on the academic record, depending on when the department processes the drop. Students with mitigating circumstances who cannot attend class on the first day should notify the instructor or academic department as soon as possible to avoid being administratively dropped. Note: Students receiving state or federal aid who receive all X, M, NP, W, or F grades for a term whose attendance during that term cannot be verified, are subject to having all their funds returned.

Academic Advising Requirements

Advising at Orientation

All new undergraduates, both freshmen and transfer students, are required to participate in New Student Orientation where they will learn about Portland State University's academic curriculum and resources, connect with an academic advisor and be given permission to register for their first term at Portland State.

Orientation http://www.pdx.edu/admissions/orientation

First-year Advising Requirement

All newly admitted undergraduates are required to connect with their assigned advisor within the first two terms of enrollment in order to register for their third term. For example, students admitted in fall term must receive advising during fall or winter terms in order to enroll for spring term or a hold will prevent them from being able to register.

First-Year Advising Requirement: www.pdx.edu/advising/first-year-mandatory-advising

Find Your Advisor: http://www.pdx.edu/advising/advising-locations

Residency Classification

At PSU tuition for Oregon residents is different from that of non-residents. The rules used in determining residency seek to ensure that only bona fide Oregon residents are assessed the resident fee. The Residency Standards used to assess residence classification may be found at www.pdx.edu/registration/residency-requirements.

Only the Office of Admissions and the Residency Officer have authority to apply and interpret these rules and procedures. No other indication or determination of residency by any other institutional office, department, program, or staff represents the official institutional determination of residency.

Residency Classification Appeals

A student may appeal their residency determination by submitting a Residence Information Affidavit with the Residency Officer in the Office of the Registrar. Information about the appeal process may be found at www.pdx.edu/registration/residency-review.

Undergraduate Students Returning to PSU After an Absence

Former Portland State University students who have been absent for two or more terms, and/or attended another college or university since leaving PSU should complete the online Re-enrollment Request Form at www.pdx.edu/registration/re-enrollment. Official transcripts must be submitted from each institution attended since leaving PSU.

Part-Time Students/Non-Degree Students

Part-time and non-degree students are subject to the same rules as full-time and admitted students with regard to Academic Standards (academic warning, probation, dismissal) and registration deadlines (drop, add, tuition refunds, grade option changes etc.). Tuition payment is required by published deadlines.

Part-time students

Part-time status is defined as enrollment in fewer than 12 credit hours for undergraduates, and fewer than 9 credits for graduate students. Credit work taken as a part-time student is acceptable for undergraduate degrees and credentials. A fully admitted student may earn most University degrees as a part-time student. Part-time students should meet regularly with an adviser for academic planning and information on up-to-date requirements and University policies.

Non-degree/non-admit students

A student may take a maximum of 8 credits in fall, winter and spring terms, and 21 in summer without applying for formal admission. A Non-Degree Entry form is used to create a student record and provide access to the registration system. There is a one time, nonrefundable fee. Non-degree students do not qualify for financial aid nor do they receive transfer credit evaluations. Non-degree students are allowed to preregister after admitted students. Students may apply online, or obtain a Non-Degree Entry form at www.pdx.edu/admissions/non-degree-applicant.

Students who wish to take 9 or more credits in fall, winter, or spring terms must be formally admitted to the University. Students who plan to earn a degree at PSU should be admitted as soon as possible. Regardless of how many credits are earned while in non-degree status, there is no guarantee of admission. Formal admission is required to earn a degree.

Postbaccalaureate Status

Students seeking admission who have earned an accredited baccalaureate degree, who have not been admitted to a graduate degree program may be admitted and enroll at the postbaccalaureate level. These students are admitted to Portland State to earn a second bachelor's degree, certificate, complete pre-requisites for admission to graduate school, or take other academic credit. PSU students who have completed an undergraduate degree who wish to complete a second undergraduate degree or take 9 or more credits during fall, winter or spring terms or more than 21 in the summer, must be admitted to postbaccalaureate status. Postbaccalaureate students are subject to the same academic policies as undergraduates.

Senior Citizen Enrollment

PSU waives tuition for courses audited by an Oregon resident 65 years of age or older if:

1. space is available after degree-seeking students have registered
2. the instructor or department approve, and
3. the auditing student is a non-degree-seeking student and is registered for 8 or fewer credits per term.

One-time administrative fees (e.g., $25 for program enrollment) and additional course-specific fees for materials and online access may apply. Registration, advising, and enrollment support are provided through the Senior Adult Learning Center (SALC).

The tuition waiver does not apply to courses with Restricted Differential Tuition. Seniors taking classes for credit pay tuition according to the established tuition schedule.

SALC receives no direct financial support from either the State of Oregon or PSU. The program relies on charitable contributions from Senior Auditors and other friends of SALC.

For further information, please email SALC (salc@pdx.edu) or visit the SALC website (www.pdx.edu/senior-adult-learning-center).

Veteran Educational Benefits Certification

503-725-8380

Most programs at Portland State University are approved for the training of veterans. The Veterans Administration requires that any veteran receiving GI Bill® benefits while attending PSU is required to obtain transcripts from all previously attended schools and submit them to the VA School Official for review for prior credit. Transcripts submitted from all previously attended schools to the Admission Office will be accessible to the VA School Official. It is not necessary to submit two copies. Each term, after registration, veteran students intending to use their education benefits must submit the Online Veterans Certification form. Course adds, drops, withdrawals, class

cancellations and changes of program made after submitting the veterans certification form must be reported as soon as possible to the Veterans Certification Office, FMH Lobby.

GI Bill® is a registered trademark of the U.S. Department of Veterans Affairs (VA). More information about education benefits offered by VA is available at the official U.S. government Web site at https://www.benefits.va.gov/gibill.

Academic Credit for Military Training

After admission, credit may be granted for some types of military service courses on the college level where equivalency to Portland State courses can be shown, as informed by the ACE recommendations. Veterans should provide transcripts from appropriate military schools and a copy of VA form DD214 to the Veterans Certification unit of the Office of the Registrar upon application to PSU.

Veteran Priority Registration

Portland State University offers early, priority registration to students using veterans' educational benefits and to veterans and military members who submit appropriate documentation. Priority registration supports timely program completion in compliance with Oregon House Bill 2565. Students being certified by the Registrar's Office for federal VA educational benefits will automatically be given veteran priority registration. Other veteran and military members can submit a copy of the DD-214 issued under honorable or general conditions to show proof of service in order to be enrolled in veteran priority registration. Submit DD214 to o the Veteran Certification Office in the FMH Lobby or to vetcert@pdx.edu.

Satisfactory Progress Standards

In order to maintain satisfactory progress, the student veteran must complete the following credits:

Certified for:	Undergraduate:	Graduate:
Full time	12+ credits	9+ credits
Three-quarter time	9 - 11 credits	7 - 8 credits
One-half time	6 - 8 credits	5 - 6 credits

The cumulative GPA at Portland State University required to maintain satisfactory progress is 2.00. VA benefits cannot be certified unless satisfactory progress standards are maintained.

One hundred and eighty (180) credits are required to graduate with a baccalaureate degree (the total is greater in some programs). Grades of No Pass, withdrawals, Incomplete, X and audits do not count toward credits completed and may result in a VA over payment.

Last Date of Attendance Reporting

For reporting purposes, the last date of attendance is established using either 1) the actual date recorded in the registration system when a course is dropped or withdrawn from, or 2) by the 'last date attended' provided by instructors when X and NP grades are submitted.

Reporting Changes in Your Enrollment

Any changes to a student's schedule, including both adding and dropping courses, must be reported to the Veterans Certification Office immediately as these changes may have a direct effect on benefits paid by the VA. Immediate notification of these changes can prevent over payments and thus prevent future problems with the VA.

Deployment Policy

Any student with orders to report for active military duty may drop courses at any time during the term and receive a full refund. If sufficient course work has been accomplished and the instructor feels justified in granting credit for the course work completed, credit may be granted and no refund will be given.

The Office of the Registrar will work with students on a case-by-case basis to determine the best course of action. Students called to active military duty generally have the following options:

- Full drop from all courses at any point during the term without academic or financial penalty, with full tuition and fee refund.
- Drop from some (but not all) courses at any point during the term without academic or financial penalty. Students who have completed a significant portion of their course work may be eligible to receive the grades earned in courses up to that point in time and/or request incomplete grades according to existing guidelines. Tuition would be refunded for withdrawn courses.
- Maintain registration in all courses. Students who have completed a significant portion of their course work may be eligible to receive the grades earned in courses up to that point in time and/or request incomplete grades according to existing guidelines. No tuition would be refunded.

A determination on which option is best for the student will depend on the student’s personal details, the time remaining in the term, the portion of coursework completed at the time of military activation, and the judgment of the instructors. Students called to active duty who want to drop courses or discuss other options, should bring a copy of their orders to the Veterans Certification Office, FMH Lobby and speak with a Veterans Certification Officer.

Veterans Access Choice and Accountability Act of 2014 (38 U.S.C. 3679(c))

In compliance with the Veterans Access, Choice & Accountability Act of 2014, the following individuals shall be charged the in-state rate for tuition and fees purposes:

- A Veteran using educational assistance under either chapter 30 (Montgomery G.I. Bill® – Active Duty Program) or chapter 33 (Post-9/11 G.I. Bill®), of title 38, United States Code, who lives in the State of Oregon while attending a school located in the State of Oregon (regardless of his/her formal State of residence) and enrolls in the school within three years of discharge or release from a period of active duty service of 90 days or more.
- Anyone using transferred Post-9/11 GI Bill® benefits (38 U.S.C. § 3319) who lives in the State of Oregon while attending a school located in the State of Oregon (regardless of his/her formal State of residence) and enrolls in the school within three years of the transferor's discharge or release from a period of active duty service of 90 days or more.
- Anyone using benefits under the Marine Gunnery Sergeant John David Fry Scholarship (38 U.S.C. § 3311(b)(9)) who lives in the State of Oregon while attending a school located in the State of Oregon (regardless of his/her formal State of residence) and enrolls in the school within three years of the Service member's death in the line of duty following a period of active duty service of 90 days or more.
- Anyone described above while he or she remains continuously enrolled (other than during regularly scheduled breaks between courses, semesters, or terms) at the same school. The person so described must have enrolled in the school prior to the expiration of the three year period following discharge, release, or death described above and must be using educational benefits under either chapter 30 or chapter 33, of title 38, United States Code.

GI Bill® is a registered trademark of the U.S. Department of Veterans Affairs (VA). More information about education benefits offered by VA is available at the official U.S. government Web site at https://www.benefits.va.gov/gibill.

Missed Class Policy

Purpose: This policy is to provide students who miss class or examinations a process to make up examinations or other graded in-class work, unless it can be shown that such an accommodation would compromise essential learning outcomes or constitute an unreasonable burden on the instructor.

Rationale: Portland State University recognizes that students carry many responsibilities with them into the classroom, which may both enrich their educational experience and make it more challenging. These include university-sanctioned activities in which the student serves as a representative to the university such as student congress, athletics, drama, and academic meetings.

Applicability:

- Students involved in university sanctioned or other legitimate activities, such as illness and family emergency.
- Activity program directors.
- Instructors of students who participate in university-sanctioned activities, including faculty, academic professionals, administrative staff, and teaching assistants.

Policy: It is the responsibility of each instructor to determine and publish the class attendance policy in the course syllabus and distribute to the enrolled students at the beginning of the quarter. The instructor may approve absences at their discretion, in accordance with this policy. It is the responsibility of the student to inform the instructor of absences due to university-sanctioned events or personal responsibilities in writing at the earliest possible opportunity. If a student must miss class due to an unforeseen event, the student must inform the instructor of the reason for the absence. Absences not cleared with an instructor before the specific class event (exam, presentation, assignment due) may require documentation/substantiation at the instructor's discretion. If the instructor decides that the absence is justifiable, then they should attempt to provide opportunities for equivalent work. When absences are approved beforehand by the student and instructor, the instructor will allow students to make up missed work and/or give an option to attain attendance points. When there is a dispute between students and instructors over the opportunity to make up work or attendances, the issue will be adjudicated by the chair of the department and then (only if needed) the dean of that school or theirr designee. The student may not place any undue burden on the instructor to provide opportunities to make up course work due to excused absences.

TUITION AND FEES

Student status

New and continuing students at Portland State University should plan their study programs and workloads with a knowledge of the fee and tuition schedules of the institution. The Portland State Board of Trustees reserves the right to change the schedule of tuition and fees without notice. Additionally, certain charges set by the University are also subject to change.

Most laboratory and class materials are included in the tuition and fees payment, but certain classes do require special deposit charges, surcharges, or costs to cover materials. These charges are listed in the class descriptions under the PSU Class Schedule registration page located at sa.pdx.edu/soc/.

An admitted student is defined as a resident or nonresident undergraduate, post baccalaureate, or graduate student enrolled for 1 or more credit and currently admitted to the University. Admitted students will be assessed tuition and fees based on enrollment status. Admitted students are entitled entry to PSU home athletic events (with the exception of playoff games and social events), and use of University resources, including the Library, Center for Student Health and Counseling (SHAC), and Student Recreation Center. Students taking 5 or more credits will be billed a health service fee as part of their tuition and fees. No reduction in the total charge is made to those students who do not intend to use specific resources or services. Student taking 5 or more credits are also entitled to Student Health Insurance at an additional cost. More information can be found at pdx.edu/health-counseling/insurance.

All non-admitted part-time students, taking 1 to 8 credits, pay tuition and fees according to the level of the course(s) in which they enroll. Courses numbered 499 or below are assessed at the undergraduate rate; courses numbered 500 and above are assessed at the graduate rate. Part-time students enrolled in 4 or less hours are not entitled to health services or insurance. Residency and admission requirements are waived for students in this category. Visit pdx.edu/registration/enrollment-status for more information.

Tuition and fee schedules/Regular tuition schedule

All students registered for coursework on or after the first day of the term have a financial obligation to the University. For more, information please see the Terms & Conditions of Payment at pdx.edu/student-financial/sites/www.pdx.edu.student-financial/files/Terms%26ConditionsofPayment.pdf.

Students should consult the tuition and fee listing at pdx.edu/student-financial/tuition-and-fees for up-to-date information and applicable tuition and fees. Students who enroll are financially responsible for all classes and credits in which they are registered on or after the first day of the term. All classes dropped are subject to the refund schedule as outlined at pdx.edu/student-financial/refunds.

Account statements are available monthly in electronic format to currently enrolled student with a balance due. Notices are emailed to pdx.edu email addresses on the 16th of every month. All tuition and fees may be paid online, by mail, or at Cashier's Office located in Student Financial Services. Specific deadlines are available at pdx.edu/student-financial/the-psu-payment-plan.

Tuition and fees must be paid in full each term. At the start of each term, students must pay the balance in full or opt-in to the PSU Payment Plan by the first payment due date. After the due date, students with a balance will be enrolled in the Payment Plan and incur a late fee. Additional information is available at pdx.edu/student-financial/the-psu-payment-plan. Students may access their individual financial account balances by logging onto my.pdx.edu.

Tuition and fee calculation (Admitted) – One credit or more

Admitted students taking one credit or more are assessed tuition and fees according to their undergraduate/graduate and residency status. The level of courses in which students enroll is immaterial.

Restricted Differential Tuition and noncredit

Enrollment in these courses may not be combined with regular PSU credit courses for fee calculations. Restricted Differential Tuition courses have fees that are assessed in addition to any other tuition paid to the University.

Senior citizen fee schedule

Senior citizens are defined as persons age 65 or older who do not wish to earn course credit. Senior citizens who are Oregon residents are authorized to attend classes on a space-available basis without payment of tuition. Charges for special materials, if any, must be paid.

Incidental and Health Service fee privileges are not provided and the University does not maintain any records of enrollment. The registration receipt may be used to obtain a PSU ID Card.

Late fees

Late payment fees will be charged on all missed payments.

Other special fees

Special fees and fines are subject to change. Up-to-date information on special fees and clarification of charges can be obtained from the Student Financial Services office, 503-725-3440 or by visiting pdx.edu/student-financial.

Terms and Conditions

Terms and Conditions can be viewed at pdx.edu/student-financial/sites/www.pdx.edu.student-financial/files/Terms%26ConditionsofPayment.pdf

In the event of withdrawal, any refunds due are applied to the outstanding balance, and any remaining balance due remains payable. Failure to pay in full may also result in denial of registration, graduation, and transcripts as well as additional assessment for collection charges and attorney's fees.

Health Insurance

The health insurance fee is non-refundable. For specific deadlines and questions, see www.pdx.edu/health-counseling/insurance.

Graduate Assistants

Graduate assistants (GAs) are fully admitted graduate students appointed to assistantships while working toward an advanced degree. Appointments must be for at least .15 FTE per quarter. GAs are exempt from the payment of the instruction fee on the first 9 credit hours per quarter. (Employing department will provide a tuition credit.) All GAs must register for a minimum of 9 graduate credits. Hours in excess of 9 per quarter are assessed at the normal rate and may be paid at the discretion of the department. GAs are responsible for paying the Building, Health, Incidental, Rec Center and any course specific fees.

Withdrawals and fee refunds

Complete withdrawal or dropping of courses can be done through my.pdx.edu or in person with the Office of the Registrar. For tuition and fee impact, see refund schedule at www.pdx.edu/student-finance/refunds. Refund consideration is automatic; no special request is necessary.

Refunds of special course fees must be approved by departments. Complete withdrawal or dropping coursework does not cancel a student's obligation to pay a student loan, balance of account, or any other financial obligation owed the University. Students with such outstanding obligations will have any refund due them applied against the obligation.

1. Official withdrawals

Students receiving financial aid who need to completely withdraw from classes during a term should officially withdraw (see the instructions in the Schedule of Classes). By using the official withdrawal procedures, students will have tuition refunds calculated by the Student Accounts Department. Regardless of "official withdraw" or Financial Aid, Student Financial Services will still calculate any possible refunds.

Students receiving financial aid who completely withdraw up to the 60 percent point of a term, will be identified. Financial aid staff will use the federal Return of Title IV Funds formula to calculate the percentage of financial aid earned versus the percentage of aid that must be returned to federal aid program accounts. In some cases, the Return of Title IV Funds calculation may take all of a student's tuition refund to repay federal aid accounts. In addition, students may be responsible for repayment of federal financial aid program funds. Funds are returned to the financial aid programs from which they were awarded, starting with the loan programs.

Students who are considering withdrawing from a term should contact staff in the Office of the Registrar.

2. Unofficial withdrawals

Students who stop attending without officially withdrawing from Portland State University are considered to have unofficially withdrawn. Students who unofficially withdraw may receive all X or M grades at the end of a term. A grade of X is defined as no basis for grade or non-attendance. A grade of M designates a missing grade.

Students who receive financial aid for a term and unofficially withdraw are identified at the end of each term. Each student receiving financial aid who has unofficially withdrawn must provide proof of attendance for the term(s). Students who provide proof of attendance may be subject to the Return of Title IV Funds policy. Students who fail to provide proof of attendance will have all financial aid received repaid to federal accounts (including PLUS loans) and a university accounts receivable will be established.

Refund calculations are based on total tuition and fees. Special fees are nonrefundable. Refunds are computed from the date of official withdrawal or drop; they are not based on when attendance in class ceased. Students who are delayed in withdrawal process for reasons beyond their control may petition for an earlier drop date via a Deadline Appeals petition obtained through the Office of the Registrar. Refund consideration is automatic; no special request is necessary. Action to process a refund cannot begin until after the end of the fourth week of the term.

FINANCIAL AID AND SCHOLARSHIPS

503-725-3461
askfa@pdx.edu

www.pdx.edu/student-finance

The staff in the Office of Student Financial Aid and Scholarships is ready to help students understand the financial aid application process and the details of the funds they have been awarded.

Eligibility

To determine students' eligibility for assistance, the following estimated direct and indirect expenses are used to create the students' Cost of Attendance: tuition and fees, books and supplies, housing and meals, transportation and personal/miscellaneous expenses. Because the Cost of Attendance uses average amounts, it may not reflect students' actual costs.

The Office of Student Financial Aid and Scholarships provides eligible students with financial aid in the form of grants and scholarships, employment and loans. Underlying the awarding of financial aid at PSU is the nationally accepted philosophy that parents are the primary source responsible for helping their dependent students meet their educational costs. The amount of the contribution expected from parents is based on a family's financial strength as indicated by taxed and untaxed income, household size, number in college, and assets. Both dependent and independent students have a responsibility to make a reasonable contribution toward their costs from earnings and savings. Financial aid resources serve to supplement these primary resources and are intended for educational expenses only. Financial aid eligibility is calculated using a formula determined by federal law.

Students should apply annually using the Free Application for Federal Student Aid (FAFSA). The FAFSA can be filed online at www.fafsa.gov. PSU's federal school code to be used on the FAFSA is 003216.

Applications for Aid

Applications for financial aid must be submitted annually for the academic year and/or summer aid. The academic year at Portland State University begins with fall term and ends after summer term. While the Office of Student Financial Aid and Scholarships accepts FAFSA data at any time during the year, priority is given to admitted applicants who submit their FAFSA as soon as possible after October 1st, and who provide all requested information promptly. It is recommended that students apply no later than February 1st each year. It is not necessary to wait for formal admission to the University before submitting the financial aid application. Scholarship applications are only accepted within the scholarship application open and close dates.

In order to be eligible to receive federal, state or institutional financial aid, students must remain in good academic standing as defined in the University Scholastic Standards Policy and by the Satisfactory Academic Progress (SAP) Policy requirements described at the end of the Financial Aid section. The student must be officially admitted to an aid-eligible degree or certificate program, and must be a U.S. citizen or eligible non-citizen as defined by federal regulations. Students may not receive aid beyond established limits, which include a rate of course completion, a maximum time frame, as well as annual and aggregate dollar amounts. Information about each aid program is available at www.pdx.edu/student-finance/types-aid.

Undergraduate students

Eligible undergraduate students may receive consideration for financial assistance through the Federal Pell Grant, Federal Supplemental Educational Opportunity Grant (SEOG), Federal TEACH Grant, Federal Work-Study, and Federal Direct Loan programs. Oregon resident students may also be eligible for the Oregon Opportunity Grant. Eligible parents of dependent students may borrow a Federal Direct PLUS Loan through the Federal Direct Loan Program, described in the Educational Loans section.

Post-baccalaureate students
Eligible post-baccalaureate students may receive consideration for financial assistance through the Federal Direct Loan Program. Parents of dependent post-baccalaureate students may borrow a Federal Direct PLUS Loan through the Federal Direct Loan Program, described in the Educational Loans section.

Graduate students
Eligible graduate students may receive consideration for financial assistance through the Federal TEACH Grant, and Federal Direct Loan Program, which includes Federal Direct Unsubsidized Loans and Federal Direct Graduate PLUS Loans.

International students
International students are not eligible to participate in federal financial aid programs but are eligible for certain scholarships offered through PSU.

Award Notification

An Award Notification will indicate the types and amounts of financial aid from all sources for which the student is eligible, along with the terms and conditions of receiving and using the funds awarded. Award amounts will be displayed on the PSU student account at my.pdx.edu. Students must review and accept the terms and conditions for specific awards if necessary, then accept or decline aid in an offered status.

Delivery of Aid

After the financial aid award is accepted and all requirements have been completed, available financial aid will be credited to the student account to pay tuition and other billed charges for enrolled students each term. Financial aid that exceeds billed charges is then delivered to the student by the Portland State University Student Financial Services Office according to the preference that the student has established with the University. See www.pdx.edu/student-finance/financial-wellness-center for more information.

Federal Work-Study is earned on a monthly basis and paychecks are issued at the end of each month by the University's payroll office. Students may authorize direct deposit of their Federal Work-Study earnings to their bank account. More information can be found at www.pdx.edu/student-finance/financial-aid/apply.

Aid Disbursement Policy

Financial aid can begin being disbursed to a student's Portland State University revolving charge student account up to ten days prior to the start of each term. Aid will only disburse if a student's registered enrollment level matches their award enrollment level for the term, and there are no outstanding requirements. The ability to disburse aid prior to the beginning of a term means that the University must have a "census date" that is used to finalize a student's official aid eligibility for a term. Census dates for the 2022-2023 aid year and minimum enrollment requirements for the various financial aid programs can be found on the Office of Student Financial Aid and Scholarships website at www.pdx.edu/student-finance/eligibility. At the census date of each term each student's enrollment is "locked" and considered to be final. Financial aid for that term may then require adjustment based on their enrollment level at that time. When a reduction in aid is required due to a student's reduced enrollment level at the census date the reduction can create a balance due on the student's PSU account. If there is a tuition refund because of dropped credits, the tuition refund will be used to reduce the balance due on the student's account.

Students applying to borrow a federal student loan must be enrolled in a minimum of halftime credit hours, have demonstrated need and/or eligible costs to receive a disbursement from the federal student loan programs.

Students who have received a disbursement of a federal student loan and then reduce enrollment below half-time at any point will be required to complete federal student loan exit counseling. The PSU Registrar's Office will report the less than half time enrollment status to the federal student loan servicer which will result in the loss of In School Deferment status. All prior federal student loans for a borrower who does not qualify for in school deferment will enter the grace period or repayment if a grace period was previously used. Students who regain eligibility to borrow from the federal student loan programs by increasing enrollment after the census date for any term must notify the Office of Student Financial Aid by submitting a Revision Request form to update their enrollment plan and request a reinstatement of their federal student loan.

Any current term aid disbursed after the census date will be based on the student's enrollment on the census date, or their actual number of credits enrolled at the time of disbursement, depending on type of aid. Credits added after the census date cannot be used to increase aid eligibility. Retroactive aid (aid for a term that has ended prior to disbursement) must be disbursed based on completed grades/credit hours, or census date registration, whichever is less. This includes retroactive grants and loans. Grades that are considered "complete" for disbursement purposes are: A, B, C, D, F (if earned through course participation), P, I or IP.

Withdrawals—Official/Unofficial

Please see the annual Registration Guide, or visit www.pdx.edu/registration, for the university policy regarding dropping classes and tuition refunds. Students who withdraw completely during the term and are receiving federal, state, or institutional financial aid may have a percentage of their aid reversed based on federal regulations and institutional policies. These students will have any unearned portion of their aid charged back to their PSU account, and may owe repayment directly to the U.S. Department of Education of any overpaid federal grants. Federal student aid recipients who begin attending classes and then stop attending prior to the end of the quarter are considered by the federal government to have unofficially withdrawn. For students who receive grades of X, M, NP, W or F in all of their classes, we must determine whether they unofficially withdrew. If University records indicate that a student unofficially withdrew from the quarter, the University will consider the withdrawal date to be the last date of attendance or participation in class by the student midpoint of the quarter as determined by the University. If University records show a federal student aid recipient never attended any class or performed any academically related activity for a quarter or term, then the recipient never established eligibility for any federal aid

funds that may have been disbursed for that quarter or term. The student must repay the entire amount of ineligible aid disbursed for that term. Any student aid recipient who drops all classes or voids their schedule with an effective date prior to the first day of class for a quarter or term did not establish eligibility for any funds that may have been disbursed for that quarter or term. More information can be found at www.pdx.edu/student-finance/eligibility.

Award Sources

Comprehensive details on the federal aid programs are available online at www.studentaid.gov. Students and families can also find Financial Aid consumer information and guides at www.pdx.edu/student-finance.

Educational Grants

Federal Pell Grant

This federally funded grant program is designed to provide assistance to eligible undergraduate students. The federal government determines the amount of the grant with the University acting as the disbursing agent. Eligibility is determined by the Expected Family Contribution (EFC) that results from the student's FAFSA data. Students have a lifetime limit that is the equivalent of 6 years of full-time enrollment for Federal Pell Grant eligibility. Students apply for this grant by completing the FAFSA.

Federal Supplemental Educational Opportunity Grant (SEOG)

This is a limited federally funded grant program available to Federal Pell Grant recipients who have the lowest EFCs. Students apply for this grant by completing the FAFSA.

Oregon Opportunity Grant

All Oregon resident undergraduate students applying for financial aid will be considered for the Oregon Opportunity Grant awarded by the State of Oregon's Office of Student Access and Completion (OSAC). Awards are based upon financial need. Details about eligibility can be found at www.oregonstudentaid.gov. Awards are renewable for up to 12 terms provided satisfactory academic progress and financial need continue each academic year. Oregon students apply for this grant by completing the FAFSA, or, if not eligible to complete the FAFSA, the Oregon Student Aid Application (ORSAA). The ORSAA can be found at www.oregonstudentaid.gov.

Federal Teacher Education Assistance for College and Higher Education (TEACH) Grant

This grant provides up to $4,000 per year to graduate and undergraduate students who intend to teach full-time as a highly qualified teacher in high-need subject areas for at least four years at schools that serve students from low-income families. Graduate students may receive up to $8,000 for graduate study. Undergraduate students may receive up to $16,000 for undergraduate study. Part-time students are eligible, but the maximum grant will be reduced. Students apply for this grant by completing the FAFSA.

Important Notice: If TEACH Grant recipients fail to complete the four-year teaching obligation, they must repay the grant with interest under the Federal Direct Loan program.

Tuition Grants, Scholarships, and Remissions

There are a variety of school funded programs that provide tuition assistance to eligible students. Students apply for these institutional programs by completing the FAFSA. More information can be found at www.pdx.edu/student-finance/financial-aid/grants.

Athletic Grants-In-Aid and Scholarships

Athletic grants-in-aid and scholarships are administered by the institution's financial aid and athletic departments. Each head coach is responsible for selecting recipients based upon eligibility and athletic ability. The National Collegiate Athletic Association (NCAA) sets forth the eligibility and financial aid requirements for Portland State University athletic teams. Any prospective PSU student should contact the coach of the desired sport about the availability of scholarships and the recruiting process. Each coach will then consider the prospective student's athletic ability, eligibility, finances available, and the need of that particular sport. An athletic grant-in-aid request is then submitted to the director of Athletics for award to the prospective student.

Educational Loans

Federal Direct Loan Program

Portland State University participates in the Federal Direct Loan program. Under this program, funding for student loans comes from the U.S. Treasury and are disbursed by schools. When loan repayments are due, borrowers repay them directly to the federal government through a loan servicer assigned by the U.S. Department of Education. Any subsequent loans are then serviced by the assigned loan servicer. Undergraduate and post-baccalaureate students can borrow Federal Direct Subsidized and Unsubsidized Loans; graduate students can borrow Federal Direct Unsubsidized Loans and Federal Direct Graduate PLUS Loans; and parents of dependent students can borrow Federal Direct Parent PLUS Loans.

Federal Direct Loan applicants must submit a FAFSA to have their loan eligibility determined. After their loans have been awarded, they must accept them as part of their financial aid award acceptance process, and complete Master Promissory Note and satisfy entrance counseling requirements at www.studentaid.gov.

Federal Direct Subsidized Stafford Loan

Subsidized loan eligibility is based upon the demonstration of financial need and in conjunction with other sources of student assistance. The federal government pays the interest on this loan while the student is enrolled at least half-time and during the six-month grace period directly after a student separates from school. For students who are new borrowers after July 1, 2013, interest is paid by the federal government up to 150 percent of the published length of the academic program. The student is responsible for all interest on the loan once repayment begins or after 150 percent of the published length of the academic program is exceeded.

The federal government has set annual borrowing limits of $3,500 for the first academic year of undergraduate study (up to 44 credits); $4,500 for the second academic year (45–89 credits); and $5,500 an academic year for the remaining years of undergraduate study. Not all students are eligible for the maximum loan amount.

Student borrowers must be enrolled in good standing at least half-time and have been accepted for admission to a program leading to a degree or eligible certificate. Once repayment begins, borrowers are charged the interest rates that were in effect for each year they borrowed. For current interest rates, visit the Department of Education's website at www.studentaid.gov/understand-aid/types/loans/interest-rates.

Students must complete a FAFSA each year to participate in this loan program.

Federal Direct Unsubsidized Stafford Loan

This program provides unsubsidized Federal Direct Loans to undergraduate and graduate students who do not demonstrate federally defined need. Unsubsidized loans are not eligible for the federal government payment of interest while the student is in school. The student may make interest-only payments while in school, or the interest will be added to the loan balance upon entering repayment. The interest rates for the Federal Direct Unsubsidized Loan are specific to each year that the student borrows. For current interest rates, visit the U. S. Department of Education's website at hwww.studentaid.gov/understand-aid/types/loans/interest-rates. Students are responsible for the interest that accrues while in school, during their six-month grace period, and during any authorized deferment periods. The federal government has set annual borrowing limits of $2,000–$5,500 for the first academic year of undergraduate study (up to 44 credits); $2,000–$6,500 for the second academic year (45–89 credits); and $2,000–$7,500 an academic year for the remaining years of undergraduate study. Undergraduate borrowing limits vary based on the borrower's dependency status as indicated by the FAFSA. Graduate students may borrow up to $20,500 per year.

Lifetime (aggregate) Federal Direct Loan Borrowing Limits by Academic Program

A student may borrow up to an aggregate limit of $31,000 (only $23,000 may be subsidized) as a dependent undergraduate or post baccalaureate student; $57,500 as an independent undergraduate or post baccalaureate student (only $23,000 of this amount may be subsidized); and $138,500 as a graduate or professional student (only $65,500 of this may be subsidized). The aggregate amount for graduate students includes all previous loans borrowed as an undergraduate or post baccalaureate student.

Additional Federal Direct Unsubsidized Stafford Loan

Dependent undergraduate students whose parents' Federal Direct Parent PLUS Loan applications are denied may be eligible for additional Federal Direct Unsubsidized Loan. Students who have earned fewer than 90 credits may borrow up to $4,000 a year in additional funds above the maximum Federal Direct Loan annual limits (but may not exceed aggregate limits). Students who have earned 90 credits or more may borrow up to an additional $5,000 per year (but may not exceed aggregate limits). Not all applicants will qualify for the maximums in additional funding. The Federal Direct Unsubsidized Loan may be used to replace the Expected Family Contribution, but total Federal Direct Loan (subsidized and unsubsidized) borrowing, plus other financial assistance received, cannot exceed the Cost of Attendance.

Students must complete a FAFSA each year to participate in this loan program.

Federal Direct Parent PLUS Loan (PLUS)

This program provides loans to parents of dependent undergraduate students. Parents may borrow up to an annual amount that is equal to the Cost of Attendance minus any financial assistance the student receives during the periods of enrollment. The parent borrower may use the amount of the Federal Direct PLUS to replace the Expected Family Contribution and cover unmet need for the loan period. The Federal Direct PLUS Loan is limited to parents who do not have adverse credit history or who have obtained an endorser who does not have adverse credit history. A servicer, contracted by the federal government, performs the required credit check. The interest on the Federal Direct PLUS Loan is fixed. For current interest rates, visit the U.S. Department of Education's website at www.studentaid.gov/understand-aid/types/loans/interest-rates.

Parents interested in participating in the Federal Direct PLUS Loan program can apply online at www.studentaid.gov.

Students must complete a FAFSA each year for their parent to participate in this loan program.

Federal PLUS Loan for Graduate and Professional Students (Graduate PLUS)

This program is available to credit-qualified graduate students with or without financial need. Repayment begins within sixty days after the Federal Direct Graduate PLUS Loan is fully disbursed. Students who meet deferment requirements may obtain an in-school deferment from the U.S. Department of Education. Interest is fixed for each loan, and begins to accrue at the time the first disbursement is made. For current interest rates, visit the Department of Education's website at www.studentaid.gov/understand-aid/types/loans/interest-rates.

Students must complete a FAFSA each year to be eligible for Federal Direct Graduate PLUS Loans.

Private Alternative Loans

Privately funded education loans are not based on need, and no federal formula is applied to determine eligibility. The amount borrowed cannot exceed the Cost of Attendance minus other financial aid, including other loans. Interest rates and repayment terms vary by lender, and should be carefully considered when making borrowing decisions. Privately funded education loans may be used to supplement the federal programs when the cost of attendance minus the maximum federal aid still leaves unmet need. For information on alternative loans, visit the PSU website at www.pdx.edu/student-finance/financial-aid/apply.

Loan Repayment

Repayment of Federal Direct Loans (subsidized and unsubsidized) begins after the grace period, which is six months after the student withdraws or graduates from school, or has been enrolled less than half-time. Repayment of Federal Direct PLUS Loans begins within sixty days of the last disbursement. There are no penalties for making payments while in school or during the grace period. Students or parents may make payments at any time directly to their loan servicer.

Entrance and Exit Counseling

First-time Federal Direct Subsidized and Unsubsidized Loan and Federal Direct Graduate PLUS Loan borrowers must complete entrance counseling, which focuses on a borrower's rights and responsibilities and provides information about responsible borrowing. Shortly before graduating or enrolling in less than half time credit hours at Portland State University, borrowers must also complete student loan exit counseling. Both entrance and exit counseling are completed online at www.studentaid.gov.

Debt Management and Default Reduction

Portland State University is committed to helping students with sound financial planning and debt management. Information about loans, repayment options, and debt management strategies is available in the Office of Student Financial Aid and Scholarships at www.pdx.edu/student-finance and through the Financial Wellness Center in the Student Financial Services office at www.pdx.edu/student-finance/financial-wellness-center.

Federal Work-Study

The Federal Work-Study Program is a limited, need-based program available to eligible undergraduate students. Employment opportunities are on-campus and off-campus. On-campus jobs are available with nearly every academic and administrative department. Off-campus jobs are available with government agencies and nonprofit groups; many are community service jobs that involve directly serving the community while providing a good work experience. The America Reads program, which tutors young children in public schools, is one of these programs. The Portland State University Career Center lists openings for on-campus and off-campus jobs at www.pdx.edu/careers. More information can be found at www.pdx.edu/student-finance.

Scholarships

Portland State University has a number of scholarships which are administered by individual academic departments, the PSU General Scholarship committee, or special committees developed for specific scholarships. Scholarships generally are awarded on the basis of academic achievement or promise, and financial need. More information can be found at www.pdx.edu/student-finance/scholarships.

Satisfactory Academic Progress and Financial Aid

To be eligible for federal, state or institutional aid students must make satisfactory academic progress (SAP), as defined by federal regulations, toward completion of their program of study. Portland State University monitors the following: 1) student's course completion rate which is a percentage calculated by taking the number of PSU + transfer credits passed divided by PSU + transfer credits attempted but not passed, according to student level; 2) grade point average (GPA) for PSU + transfer courses, according to student level; and 3) maximum time frame for PSU courses + accepted transfer credits. The maximum time frame for undergraduate students is 270 attempted credits. The maximum time frame for post-baccalaureate students is 90 attempted credits. The maximum time frame

for graduate students is established according to the student's degree or program.

Repeated coursework: students may only receive aid once for repeating a previously passed class; students may receive aid for multiple repeats of failed classes as long as they maintain compliance with satisfactory academic progress requirements.

Multiple withdrawals: financial aid recipients who withdraw from all of their classes, or who receive all non-passing grades in their classes TWICE within the school year, will have their financial aid eligibility suspended.

Graduate students must take courses at the appropriate level; at least 67% of all credits enrolled in during each academic year must be graduate level courses.

Students who do not meet all requirements of the satisfactory academic progress policy during a term will be placed on Financial Aid Warning; students who do not meet all requirements of the satisfactory academic progress policy during a second term will have their eligibility for financial aid suspended. Students whose eligibility is suspended may submit a written appeal. Students who appeal successfully will be placed on Financial Aid Probation and may need to submit and follow an academic plan.

For more information on Portland State University’s SAP Policy, visit www.pdx.edu/student-finance/satisfactory-academic-progress.

MASEEH COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

Joseph Bull, Dean
Chris Monsere, Associate Dean for Academic Affairs
Antonie Jetter, Associate Dean for Research
James Hook, Associate Dean for International Partnerships
Tong Zhang, Assistant Dean for Inclusive Innovation
TBD, Assistant Dean for Finance & Administration
Suite 500, Engineering Building
www.pdx.edu/engineering/

- B.S.—Civil Engineering, Computer Engineering, Computer Science, Electrical Engineering, Environmental Engineering and Mechanical Engineering
- Minor in Computer Science, Electrical Engineering, Environmental Engineering
- M.S.—Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Engineering and Technology Management, Mechanical Engineering, and Materials Science and Engineering
- M.Eng.—Civil and Environmental Engineering
- Ph.D.—Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mechanical Engineering, Technology Management
- Ph.D.—Participating college in Systems Science Doctoral Program
- Ph.D.—Participating college in Environmental Sciences and Resources Doctoral Program
- Graduate Certificates

Engineering and computer science professions will continue to be front and center in addressing grand challenges that affect society and the planet, from reinventing the built environment for human health to low-impact energy sources, and resilient physical and cyber systems to effective transportation networks. For these reasons, national projections indicate that the need for engineers and computer scientists will continue to increase significantly during the years ahead, with commensurate increases in what are already high wages and opportunities to make substantial positive differences in the world.

All undergraduate programs require a core of engineering or computer science, mathematics, science, and liberal arts courses. Graduate programs provide extended educational opportunities in various engineering and computer science specialties, from cyber-security to healthy buildings, environmental monitoring to resilient infrastructure, technology management to nano-fabrication, water resources to artificial intelligence, neurosystems and robotics to power systems, and more.

Undergraduate programs

Our undergraduate programs are accredited as follows:

- Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Civil and Similarly Named Engineering Program Criteria.
- Environmental Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Environmental Engineering and Similarly Named Engineering Program Criteria.
- Electrical Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Program Criteria.
- Computer Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Program Criteria.
- Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Mechanical and Similarly Named Engineering Criteria.
- Computer Science program is accredited by the Computing Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Computer Science and Similarly Named Computing Program Criteria

DEGREE MAPS AND LEARNING OUTCOMES

Please refer to each department to view the degree maps and expected learning outcomes for Engineering and Computer Science's undergraduate degrees.

ADMISSION REQUIREMENTS

Policy on admission to undergraduate programs

Students may declare engineering or computer science as their major at any time after enrolling at Portland State University. However, students must be admitted formally to a specific degree program in civil engineering, computer engineering, computer science, electrical engineering, environmental engineering or mechanical engineering before they will (1) be allowed to enroll in restricted upper-division courses offered by the program and (2) be graduated from that program. Students apply for formal department admission one to two terms before completing all eligibility requirements. Specific department application deadlines, criteria for admission and applications are available at the Maseeh College website: www.pdx.edu/engineering/upper-division-admissions.

Students transferring from other institutions who want to be admitted formally to a specific engineering degree program (civil engineering, computer engineering, computer science, electrical engineering, environmental engineering, mechanical engineering) must:

- Meet all eligibility requirements.
- Apply for admission to PSU.
- Apply for program admission to the Maseeh College of Engineering and Computer Science

Transfer students should consult the information and transfer guides posted on the Maseeh College website: www.pdx.edu/engineering/transfer-admissions

Transfer courses that are not evaluated by the Office of the Registrar or specified in other MCECS agreements as discrete numbered/direct equivalent courses will be evaluated by the department chair or their designee. In addition to the transcript, the student requesting the specific course equivalency may be asked to provide catalog descriptions and/or documents certifying course content. To ensure that the student is well prepared for the current curriculum, course equivalency will be evaluated against the content of the current course. Appeals of transfer course equivalence may be made to the MCECS Associate Dean.

Please see department websites for more specific admissions information.

Graduate programs

The Maseeh College of Engineering and Computer Science offers graduate programs leading to the degrees of Master of Science, Master of Engineering, Master of Software Engineering, and Doctor of Philosophy.

Master's programs are available in civil and environmental engineering, computer science, software engineering, electrical and computer engineering, mechanical engineering, engineering & technology management, materials science and engineering, and systems engineering.

Ph.D. programs are available in civil and environmental engineering, computer science, electrical and computer engineering, mechanical engineering, and technology management.

Graduate Certificates are also available in select departments.

Master of Software Engineering

Suite 120
Fourth Avenue Building

- M.S.E.—Master of Software Engineering
- Graduate Certificate in Software Engineering

Applications to the Master of Software Engineering and the Graduate Certificate in Software Engineering have been suspended pending a major curriculum revision.

Systems Engineering

- M.Eng.— Systems Engineering
- Graduate Certificate

Systems Engineering is the practice of creating the means of performing useful functions through the combination of two or more interacting elements. Systems engineering focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then continuing with design synthesis and system validation while considering the complete problem. Systems engineering integrates all the disciplines and specialty groups into a team effort, forming a structured development process that proceeds from concept to production to operation. Many of us already practice systems engineering, but call it something else: design or development of product, process, service. This course of study will enable the engineer to function in an interdisciplinary team and apply their area of engineering specialty toward the development of a product, process, or service.

ADMISSION REQUIREMENTS

Master of Engineering and Graduate Certificate

In addition to meeting general University admission requirements (p. 44), applicants to the program need a minimum of three years of professional experience, baccalaureate degree, and at least 2.50 GPA. Admission is based on program approval by the Director of Systems Engineering and the PSU Admissions office.

8. Submit the written dissertation in compliance with University guidelines and deadlines.

Internship credits (CE 604) require a project and final report; these credits must be arranged in advance between the CEE faculty advisor and the student. CEE courses for which the student receives a grade of "C+" or lower will not be counted toward fulfilling the requirements. Grades of C+, C, or C- may sometimes be counted toward the degree with the approval of the student's advisor and the Graduate Program Chair.

All courses taken in the Department of Civil and Environmental Engineering by degree candidates must be taken for a letter grade, unless a course is only offered with a pass/no pass option. Courses outside the Department of Civil and Environmental Engineering may be taken pass/no pass only with the consent of the student's advisor. Non-degree seeking students may take Civil and Environmental Engineering courses pass/no pass with the consent of the instructor.

Departmental policies and other helpful information for graduate students can be found in the Department's Graduate Handbook, located on the CEE website. All other degree requirements for the PhD program are established by PSU's Graduate School. Please refer to the Graduate School for the university's doctoral degree requirements.

HYDROLOGY GRADUATE CERTIFICATE

The Graduate Certificate of Hydrology (p. 265) is designed to give students advanced training in hydrology, and leads to professional certification with the American Institute of Hydrology (AIH). Additional information about the certificate can be found on the Environmental Science and Management Department website.

SUSTAINABILITY GRADUATE CERTIFICATE

The Graduate Certificate in Sustainability (p. 404) offers an integrated series of post-baccalaureate courses that allow students to deeply explore and understand the three spheres of sustainability: social, economic, and environmental. The courses cover theory as well as practice, providing experience analyzing real-world approaches and solutions. Courses can be taken by students admitted solely to the certificate program or concurrently enrolled in masters and doctoral programs at PSU. The certificate is administered by the Economics department. More information about the certificate and application procedures can be found on the Economic Department's website.

TRANSPORTATION GRADUATE CERTIFICATE

The Graduate Certificate in Transportation (p. 426) is a 21 credit hour program designed to build the technical and analytical knowledge of those who are in or wish to enter the transportation field. This program could be completed in a single year on a full-time basis or over two years on a part-time basis. The certificate includes courses from the Toulan School of Urban Studies and Planning and the Department of Civil and Environmental Engineering. Credits taken as part of this certificate program may be used to satisfy partial M.S. degree requirements in either program. Admission to this program will require an undergraduate degree at an accredited university and a GPA that meets university admission requirements. More information about the certificate and application procedures can be found on the School of Urban Studies and Planning website.

Computer Science

120 Fourth Avenue Building
503-725-4036
www.pdx.edu/computer-science/

- B.S.—Computer Science
- Minor in Computer Science
- M.S.—Computer Science
- Ph.D.—Computer Science
- Graduate Certificate in Computer Security

The Department of Computer Science offers a full range of courses and degree programs that are designed to provide students with the educational background to achieve a career in the computing industry. We offer a community to learn, discover, innovate, and share a curriculum based on the application and theoretical foundations of Computer Science. Our faculty members specialize in a variety of research areas such as artificial intelligence & machine learning; computer science education; computer security & privacy; computer vision & computer graphics; data science; natural language processing; programming languages & formal methods; software engineering; systems & networking; and theory.

Undergraduate program

The undergraduate computer science program is designed to provide students with the educational background required for a professional career in the computing industry and for further study at the graduate level. The program includes a core of required courses and an elective program of courses over a wide range of topics. Seniors work in teams to carry out community-based projects during the two-term capstone course in software engineering.

The undergraduate Computer Science program is accredited by the Computing Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Computer Science and Similarly Named Computing Program Criteria.

DEGREE MAPS AND LEARNING OUTCOMES

To view degree maps for the undergraduate program, visit www.pdx.edu/academics/programs/undergraduate/computer-science. Expected learning outcomes are listed at www.pdx.edu/computer-science/program-objectives-outcomes.

PROGRAM OBJECTIVES

The objectives of the undergraduate program in computer science are to produce graduates with:

- The knowledge and skills necessary for career success.
- A commitment to uphold the highest standards of professionalism, integrity, and ethical behavior.
- The motivation and preparation to adapt to rapidly changing technology, and to engage in life-long learning.

ADMISSION REQUIREMENTS

Students who are intending to graduate with an undergraduate degree in Computer Science must be admitted to Portland State University and complete an opt-in for the Computer Science major after satisfying the lower-division requirements described below. Students with questions should contact the Computer Science Department. No more than 8 upper-division CS course credits (including any approved upper-division transfer credits) taken prior to admission to the program will be counted toward the student's departmental requirement of upper-division CS courses. Students also must be in admitted status during the term they intend to graduate.

Computer Science Admission Requirements

Applies to students pursuing a B.S. in Computer Science wishing to enroll in upper-division CS courses for the 2023-24 academic year.
Computer Science Department website:
www.pdx.edu/computer-science

Terms of Admission & Deadlines

- Completing an opt-in for admission to the Computer Science major requires a copy of the student's DARS report, showing that they have passed all of the courses that are required for admission.
- Although there are no formal deadlines, students are strongly encouraged to complete the opt-in as soon as possible in the term after they have satisfied the admission requirements, so as to avoid delays in being able to register for upper-division CS courses for the following term.
- The opt-in form is available from the Computer Science Department website at www.pdx.edu/computer-science/undergraduate-admission.
- A detailed four-year course plan/sample schedule is provided by the "Computer Science Blue Sheet", which is available at www.pdx.edu/computer-science/bachelor.

Requirements for Admission to the Computer Science Major

1. Completion of each of the following core CS courses with a C or better.

- CS 161 Introduction to Programming and Problem Solving (4) (This requirement will be waived for students who have completed CS 162 prior to Fall 2022)
- CS 162 Intro to Computer Science (4)
- CS 163 Data Structures (4)
- CS 205 System Programming and Architecture (4)
- CS 250 Discrete Structures I (4)
- CS 251 Discrete Structures II (4)

2. Completion of each of the following non-CS courses with a grade of C- or better.

- MTH 251 Calculus I
- MTH 252 Calculus II or MTH 261 Linear Algebra
- Three Approved Laboratory Science courses

Prior to admission, PSU students are expected to complete the Freshman and Sophomore Inquiry series. Similarly, transfer students are expected to complete the Maseeh College lower division general education requirements. Completing the general education requirements prior to admission will allow students to focus on CS major courses and likely result in a shorter time to graduation.

Appeals

- Students denied admission to the Computer Science program may submit a written appeal which will then be reviewed by the department's Appeals Committee. All decisions are final.

Priority Registration

- Most applicants will have completed 90 credits by the time they complete the opt-in. This gives them registration priority over students that have completed less than 90 credits. Students who complete the opt-in with less than 90 credits may find classes are full by the time they are able to register. The Computer Science Department is unable to provide overrides to allow earlier registration.

Pass/No Pass

- All required classes must be taken for a grade (not P/NP) unless they are only offered as P/NP.
- There is no GPA penalty for a Pass or No Pass (but the student may be required to retake the class for a letter grade).

Additional Information (exceptions, preferences, etc.)

- No preference is given to PSU students versus students who completed required courses elsewhere.

Continuation Criteria

- Admitted CS undergraduate students who are not making acceptable progress towards their degree requirements will be dropped from the program and required to reapply for admission. Acceptable progress is defined as completion of at least eight credits of coursework with acceptable grades (C or better for required CS courses, C- or better for required non-CS courses), satisfying departmental requirements, over the preceding academic year. Readmission will be determined by the CS Undergraduate Committee.

Prerequisite Policy

- In order to enroll in most upper-division or graduate CS courses, students must be admitted to the Computer Science program or have the instructor's permission. Before enrolling in any CS course, students should read the course descriptions and ensure that they have completed all prerequisites with a C or better for undergraduate courses, or a B or better for graduate courses. Students who have not met this requirement or who do not meet applicable admission requirements may be administratively dropped from the course.
- A limited set of upper division CS courses, designated "dual use courses", may be taken prior to admission, subject to completion of the associated prerequisites. Students should not take a total of more than 8 credits of upper division CS courses, including any dual use courses, before they have been admitted to the CS major. To avoid a gap in available courses that could delay progress to graduation, students should not generally take dual use courses before they have completed the admission requirements. Students are strongly encouraged to consult the CS Department website, or to meet with an advisor, for further details.

Laptop Requirement

- Students registering for upper-division (300- or above) CS courses, must have access to a laptop with wireless Internet access meeting a set of minimum requirements. These minimum requirements can be found on the computer science website at www.pdx.edu/computer-science/laptop. Chromebooks, iPads, and similar devices do not meet the requirements to run many applications that may be used in various CS courses.

Department Communication

- Academic year 2023-24 admission requirements are available the preceding academic year's spring term (Spring 2023).

COMPUTER SCIENCE B.S.

Majors in computer science must complete the following University and departmental degree requirements.

1. All computer science courses used to satisfy the departmental major must be graded C or better. Courses taken outside the department as part of departmental requirements must be graded C- or better. If a course is offered only on a Pass/No Pass (P/NP) grading scale, it must be graded as a Pass.
2. All courses specifically required by the department must be taken for a letter grade unless a required course is only offered with a Pass/No Pass option.
3. After admission to the computer science program, students are required to complete a minimum of 44 upper-division computer science credits in residence at PSU.
4. Freshmen entering with 29 or fewer prior university/college credits must complete all University Studies requirements, including freshman and sophomore inquiry sequences and upper-division cluster courses.
5. Transfer students must have a minimum of 39 credits of University Studies courses and/or arts and letters/social science courses prior to graduation; 12 of these credits are upper-division cluster courses that must be taken at PSU. Transfer students should consult with the CS departmental adviser for more information.

The following is a sample curriculum. Students choosing to make modifications to this schedule are urged to consult with an adviser.

REQUIREMENTS

Freshman year

CS 161	Introduction to Programming and Problem-Solving	4
CS 162	Introduction to Computer Science	4
Mth 251	Calculus I	4
Mth 252	Calculus II	4
	Approved Laboratory Science	15
	Freshman Inquiry	15
		Subtotal: 46

Sophomore year

CS 163	Data Structures	4
CS 205	System Programming and Architecture	4
CS 250	Discrete Structures I	4
CS 251	Discrete Structures II	4
Mth 253	Calculus III	4
	or	
Mth 261	Introduction to Linear Algebra	4
	Sophomore Inquiry	8
	Free electives	16
		Subtotal: 44

Junior year

CS 302	Programming Methodologies and Software Implementation	4
CS 314	Elements of Software Engineering	4
CS 333	Introduction to Operating Systems	4
CS 350	Algorithms and Complexity	4
CS 486	Introduction to Database Management Systems	4
	Approved upper-division programming intensive CS elective	4
	Approved Computer Science security elective	4
ECE 341	Introduction to Computer Hardware	4
Wr 227Z	Technical Writing	4
	Upper-division cluster	12
		Subtotal: 48

Senior year

CS 305	Social, Ethical, and Legal Implications of Computing	2
CS 358	Principles of Programming Languages	4
CS 469	Software Engineering Capstone I	3
CS 470	Software Engineering Capstone II	3
	Approved upper-division computer science electives	16
	Approved Math electives	7
	Free electives	7
		Subtotal: 42

Note: The University requires all students to have a minimum of 62 upper-division credits to graduate. Since fewer than 62 upper-division credits are required in computer science, mathematics, and general education for the computer science major, the extra credits of upper-division work must be taken from either the approved math or the free electives.

UPPER DIVISION CREDITS

Approved Computer Science security elective

Students must complete one course related to the principles and practices for secure computing. The current list of approved courses includes:

CS 491	Introduction to Computer Security	4
CS 495	Web and Cloud Security	4
CS 496	Network Security	4

Approved upper-division Computer Science electives

The total may include any regular 300- and 400-level computer science course, and any of the courses:

ECE 485	Microprocessor System Design	4
ECE 486	Computer Architecture	4

except that no more than a total of 4 credits may be taken from:

CS 401	Research	1-6
CS 405	Reading and Conference	1-6
CS 406	Special Projects	1-6
CS 407	Seminar	1-6
CS 409	Practicum	1-9

At least 4 credits of approved "Programming Intensive" courses must be taken. These courses can be identified by the "P" suffix in the course number (e.g., CS 410P, CS 465P, CS 494P, etc.). Additionally, CS 404, University Studies courses, and courses specifically described as not being applicable to the CS degree may not be used.

Approved Laboratory Science

Students must select 3 courses from the following, including their associated laboratories:

Biology:

Bi 211	Principles of Biology: Biology of Cells	4
Bi 212	Principles of Biology: The biology of organisms	4
Bi 213	Principles of Biology: Evolution and ecology of living organisms	4

	With	
Bi 214	Principles of Biology Lab I	1
Bi 215	Principles of Biology Lab II	1
Bi 216	Principles of Biology Lab III	1
Chemistry:		
Ch 221	General Chemistry I	4
Ch 222	General Chemistry II	4
Ch 223	General Chemistry III	4
	With	
Ch 227	General Chemistry Laboratory	1
Ch 228	General Chemistry Laboratory	1
Ch 229	General Chemistry Laboratory	1
Geology:		
G 201	Dynamic Earth: Interior	3
G 202	Dynamic Earth: Surface	3
	With	
G 204	Geology Laboratory	1
G 205	Geology Laboratory	1
Physics:		
Ph 201	General Physics	4
Ph 202	General Physics	4
Ph 203	General Physics	4
Ph 211	General Physics (with Calculus) I	4
Ph 212	General Physics (with Calculus) II	4
Ph 213	General Physics (with Calculus) III	4
Ph 221	General Physics (with Calculus) I	3
Ph 222	General Physics (with Calculus) II	3
Ph 223	General Physics (with Calculus) III	3
Ph 231	General Physics I with Life Science and Medical Applications	4
Ph 232	General Physics II with Life Science and Medical Applications	4
Ph 233	General Physics III with Life Science and Medical Applications	4
	With	
Ph 214	Lab for Ph 201 or Ph 211 or Ph 221 or Ph 231	1
Ph 215	Lab for Ph 202 or Ph 212 or Ph 222 or Ph 232	1
Ph 216	Lab for Ph 203 or Ph 213 or Ph 223 or Ph 233	1

Credit is only given for General Physics Ph 201-Ph 203, Ph 211-Ph 213, Ph 221-Ph 223, Ph 231-Ph 233 one time. You may not receive duplicate credit.

Approved Mathematics electives

Students must complete 7 or more credits of approved mathematics electives. The current list of approved courses includes:

Mth 261	Introduction to Linear Algebra	4
Mth 311	Introduction to Mathematical Analysis I	4
Mth 343	Applied Linear Algebra	4
Mth 344	Introduction to Group Theory and Applications	4
Mth 346	Number Theory	4
Mth 356	Discrete Mathematics	4
Mth 457	The Mathematical Theory of Games I	3
Mth 458	The Mathematical Theory of Games II	3
Mth 461	Graph Theory I	3
Mth 462	Graph Theory II	3
Stat 366	Introduction to Experimental Design	4
Stat 451	Applied Statistics for Engineers and Scientists I	4
Stat 452	Applied Statistics for Engineers and Scientists II	3
Stat 464	Applied Regression Analysis	3
Stat 467	Applied Probability I	3
Stat 468	Applied Probability II	3

Other upper-division mathematics or statistics courses may be used to satisfy the requirement with prior written approval from the Computer Science Undergraduate Adviser.

COMPUTER SCIENCE MINOR

A minor in computer science is available within the Maseeh College of Engineering and Computer Science in the area of computer science.

REQUIREMENTS

To earn a minor in computer science, a student must complete 24 credits as follows:

Courses

CS 161	Introduction to Programming and Problem-Solving	4
CS 162	Introduction to Computer Science	4
CS 163	Data Structures	4
CS 205	System Programming and Architecture	4
CS 250	Discrete Structures I	4
	Approved CS Minor course	4

Only grades of C or better count toward departmental requirements. At least 12 of the required 24 credits must be taken at Portland State University.

Approved CS Minor courses include any lower-division or upper-division Computer Science course. Some upper-division courses are reserved for Computer Science majors and may require permission from the instructor in order to register.
Subtotal: 24

COMPUTER SCIENCE - HONORS TRACK

The honors degree in computer science requires the writing of an honors thesis. Details about the program can be found on the computer science website at www.pdx.edu/computer-science/honors-track.

BIOMEDICAL INFORMATICS PROGRAM

Portland State University and Oregon Health & Science University offer an accelerated, collaborative degree program in biomedical informatics. Designed for high achieving freshmen, this program combines courses from both schools to award a B.S. in computer science and Master of Biomedical Informatics at the end of five years. Details about the program can be found on the computer science website at www.pdx.edu/computer-science/biomedical-informatics.

Graduate Programs

ADMISSIONS REQUIREMENTS

To be considered for admission to the graduate program in computer science, the student must have a four-year baccalaureate degree from an accredited institution. Prospective graduate students are not required to have a bachelor's degree in Computer Science, but they must make up the background needed for graduate study before applying for admission. The Grad Prep program described at https://www.pdx.edu/computer-science/grad-prep may be helpful in developing knowledge of the core curriculum of an undergraduate computer science degree.

A cumulative undergraduate GPA of at least 3.00 is required. See the CS graduate admissions webpage for the admission and application requirements: https://www.pdx.edu/computer-science/graduate-admission.

Students may apply to the Ph.D. program with or without having already obtained an M.S. in computer science.

COMPUTER SCIENCE M.S.

The Master's program in computer science is designed to prepare students for advanced careers in the computer industry, to create a research environment in computer science, and to prepare students for graduate work at the Ph.D. level.

See University Master's degree requirements. The Master's program in computer science consists of two options. The first option involves the completion of an approved program of 45 credits. The second option requires the completion of an approved program of 45 credits, which includes 6 to 9 credits of thesis. In both options, the coursework includes core courses in theory and programming practice, plus a 9-credit concentration in one of the tracks described below. For the thesis option, successful completion of a final oral examination covering the thesis is required. For more information, visit: https://www.pdx.edu/computer-science/master.

CORE COURSE REQUIREMENT

One theory course from:

CS 581	Theory of Computation	3
CS 584	Algorithm Design and Analysis	3
CS 578	Programming Language Semantics	3

Subtotal: 3

One programming practice course from:

CS 558	Programming Languages	3

Or any 500-level course designated by the department as a "Programming Intensive" course, as indicated by the "P" suffix in the corresponding 400-level course number.
Subtotal: 3

ELECTIVES

Students must take enough electives to complete 45 total credits for the Master's degree. Electives can be any 500-level CS course and may include up to 6 credits of CS 505 (Reading and Conference) and CS 506 (Special Projects). CS 501 Research, CS 502 Independent Study, CS 504 Internship, and CS 509 Practicum credits cannot be applied. A limited number of credits taken outside Computer Science can count towards the elective requirements, with advisor approval. A minimum of 30 credits must be taken in Computer Science at Portland State University. Given this, students may use a combined total of 15 pre-admission, transfer, and non-CS credits toward their Master's degree with advisor approval. One additional credit beyond the 15 credit limit can be used provided none of the courses are a 1-credit course.

- Pre-admission credits (taken before the term of formal admission) can include both transfer and PSU credits. Pre-admission credits taken at PSU are requested via a DARS exception submitted to the Graduate School. This request should be made soon after admission to the graduate program.

- Transfer credits refer to credits taken from another institution other than PSU. To request approval of transfer credits, complete and submit the GO-21M form (Proposed Transfer Credit) to the CS Graduate Advisor. Students should submit the GO-21 form during the first term of enrollment in the program, so there is sufficient time to complete any additional coursework that may be necessary. Any transfer credits must be approved before graduation paperwork can be processed. OHSU joint campus credits are considered transfer credits and are transferred via a different process. For more information, visit: www.pdx.edu/gradschool/joint-campus-registration.
- Non-CS credits taken outside of Computer Science, such as ECE or Math, can count towards elective requirements once approved. Students should obtain advisor approval in advance to avoid the risk of taking a course that will not be approved. To request approval, submit a plan of study with the courses listed to the Graduate Advisor. Non-CS courses must be graduate level. All ETM courses are eligible to transfer but students are limited to using only one for the CS degree requirements.

Subtotal: 30

TRACK REQUIREMENT

Take three courses from one of the following tracks:

Databases

Covers concepts, languages, implementation and application of database management systems. Other topics that have been offered in the track include formal foundations of databases, databases for cloud and cluster environments, and data stream systems.

CS 586	Introduction to Database Management Systems	3

And two courses from the following*:

CS 530	Internet, Web, & Cloud Systems	3
CS 587	Database Management Systems Implementation	3
CS 588	Cloud and Cluster Data Management	3
CS 589	Blockchain Development & Security	3

*Or any approved CS 510 course in Databases.

Languages and Programming

Focuses on the design, implementation, and use of programming languages. It includes exposure to a variety of programming paradigms, experience using programming languages to express the essential abstractions of a problem domain, courses on programming language implementation, and the study of formal methods for specifying and reasoning about programs and programming languages.

CS 558	Programming Languages	3

Two courses from the following*:

CS 515	Parallel Programming	3
CS 520	Object-Oriented Programming & Design	3
CS 553	Design Patterns	3
CS 557	Functional Programming	3
CS 578	Programming Language Semantics	3

*Or any approved CS 510 course in Languages and Programming.

Security

Focuses on protecting computing systems and user data from unauthorized access and use. Topics include cryptography, network and host-based access control, vulnerability analysis, penetration testing, and reverse engineering.

CS 591	Introduction to Computer Security	3

Two courses from the following*:

CS 530	Internet, Web, & Cloud Systems	3
CS 576	Computer Security Research Seminar	3
CS 585	Cryptography	3
CS 592	Malware Reverse Engineering	3
CS 593	Digital Forensics	3
CS 595	Web and Cloud Security	3
CS 596	Network Security	3

*Or any approved CS 510 course in Security.

Software Engineering

Studies the principles, processes, techniques, and tools for building software systems. Topics include software requirement, design, development, validation, and maintenance.

CS 554	Software Engineering	3

Two courses from the following*:

CS 530	Internet, Web, & Cloud Systems	3
CS 552	Building Software Systems with Components	3
CS 553	Design Patterns	3
CS 555	Software Specification and Verification	3
CS 556	Software Implementation and Testing	3

CS 561	Open Source Software Development Laboratory	3

*Or any approved CS 510 course in Software Engineering.

Systems and Networking

Studies the design and implementation of operating systems, wired and wireless computer networks including high performance computer systems, data centers, cloud computing architectures, distributed systems, fault tolerance, concurrency, systems programming, and theoretical topics related to these areas.

CS 533	Concepts of Operating Systems	3
CS 594	Internetworking Protocols	3

One course from the following*:

CS 515	Parallel Programming	3
CS 530	Internet, Web, & Cloud Systems	3
CS 531	Introduction to Performance Measurement, Modeling and Analysis	3
CS 535	Accelerated Computing	3
CS 538	Computer Architecture	3
CS 572	Operating System Internals	3
CS 590	Introduction to Multimedia Computing and Networking	3
CS 598	Introduction to Wireless Network Protocols	3
ECE 586	Computer Architecture	4

*Or any approved CS 510 course in Systems and Networking.

Artificial Intelligence and Machine Learning

Covers modern algorithms underlying intelligent and learning systems. Examples of topics covered in this track include knowledge representation, planning, reasoning, combinatorial and adversarial search methods, natural language processing, computer vision, statistical machine learning, and evolutionary and reinforcement learning.

CS 541	Artificial Intelligence	3
CS 545	Machine Learning	3

One course from the following*:

CS 542	Advanced Artificial Intelligence: Combinatorial Games	3
CS 543	Advanced Artificial Intelligence: Combinatorial Search	3
CS 546	Advanced Topics in Machine Learning	3
CS 570	Machine Learning Seminar	1
Stat 671	Statistical Learning I	3
Stat 672	Statistical Learning II	3
Stat 673	Statistical Learning III	3

*Or any approved CS 510 course in Artificial Intelligence or Machine Learning.
Subtotal: 9

Total Credit Hours: 45

Cumulative Graduate GPA

Students must have a graduate GPA of 3.0 or above in all graduate level coursework taken at PSU to graduate from a master's degree, doctoral degree, or graduate certificate program at PSU.

Degree Program GPA

Students must have a GPA of 3.0 or above in all courses being used to meet the degree requirements. All graded courses must be passed with a grade of B- or better. Core requirements must be passed with a grade of B or better. All courses taken Pass/No Pass must be passed. Students must have the minimum number of credits needed for their degree before they can graduate.

Application for Graduation

Students must apply for graduation no later than the first Friday of the term in which they wish to graduate. Information about applying for graduation can be found at: https://www.pdx.edu/gradschool/applying-for-graduation.

COMPUTER SCIENCE PH.D.

The doctoral degree program in Computer Science is designed to prepare students for advanced research or university teaching in the field.

See University doctoral degree requirements. The student must complete an approved program of 90 graduate credits, including 18 credits of core courses and 27 credits of dissertation research. To be admitted to Ph.D. candidacy, a student must pass the Research Proficiency Examination (RPE) and must present an acceptable dissertation proposal. The dissertation comprises original research work, which is expected to be of a quality meriting publication in a refereed journal or conference. For more information, visit: www.pdx.edu/computer-science/doctor-philosophy-phd.

CYBERSECURITY GRADUATE CERTIFICATE

The cybersecurity certificate program requires admission as a graduate student, similar to admission to the Master’s program, in the Computer Science department. The program requires 21 total credits of graduate classes. There are two core classes for a total of 6 credits. In addition, five elective classes must be taken for the needed additional 15 credits. In summary, seven total graduate classes must be taken; two are core and five are electives.

Required Core Courses		
CS 591	Introduction to Computer Security	3
CS 595	Web and Cloud Security	3
Subtotal: 6		

Five of the following courses*:		
CS 554	Software Engineering	3
CS 555	Software Specification and Verification	3
CS 556	Software Implementation and Testing	3
CS 576	Computer Security Research Seminar	3
CS 585	Cryptography	3
CS 592	Malware Reverse Engineering	3
CS 593	Digital Forensics	3
CS 594	Internetworking Protocols	3
CS 596	Network Security	3

*Or any CS 510 course in Security.
Subtotal: 15

Total Credit Hours: 21

Electrical and Computer Engineering

1900 SW Fourth Ave., Suite 160
503-725-3806
www.pdx.edu/electrical-computer-engineering/

- B.S.—Computer Engineering
- B.S.—Electrical Engineering
- Minor in Electrical Engineering
- M.S.—Electrical and Computer Engineering
- Ph.D.—Electrical and Computer Engineering

Mission, Vision & Values

Mission

We prepare students for successful engineering careers and lifelong learning, and we conduct research that creates new technologies and engineering knowledge.

Vision

Our vision is to be a source of premier electrical and computer engineering talent and high-impact research. This means our graduates are successful, our research is recognized worldwide, and we are the intellectual center for our discipline in the Portland region.

Values

We value

- The success of our graduates
- Contributions to research and knowledge creation
- High intellectual and ethical standards
- High quality education for traditional and nontraditional students
- A diverse student population
- Our contribution to the Oregon economy
- Lifelong learning
- Technical and professional relationships with the engineering community

Undergraduate programs

The Department of Electrical and Computer Engineering offers programs in electrical and computer engineering. Cooperative educational arrangements with Portland-area industries, government agencies, and engineering consulting offices are available to qualified students. Qualified freshmen are encouraged to participate in the University Honors Program. Qualified upper-division students should consider the Electrical and Computer Engineering departmental honors track as described below.

The Electrical Engineering and Computer Engineering programs are accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Program Criteria.

DEGREE MAPS AND LEARNING OUTCOMES

To view the degree maps and expected learning outcomes for Electrical and Computer Engineering's undergraduate degrees, go to www.pdx.edu/academic-programs/a-z.

PROGRAM EDUCATIONAL OBJECTIVES

The electrical and computer engineering programs prepare our graduates for the following program educational objectives:

1. Graduates are expected to be employed as electrical or computer engineers or in related fields that benefit from an electrical and computer engineering education.
2. Graduates are expected to advance in their profession and engage in the professional community.
3. Graduates are expected to continue to learn and adapt in a world of constantly changing environment and technology.

ADMISSION REQUIREMENTS

CS - Computer Science

CS 105 - Computing Fundamentals I (4)

Intended as an overview of computers and computer technology for non-CS majors, this course is often described as a computer literacy course. The primary focus is on the personal computer and personal productivity software. Hardware components of computers such as processors, memory, and input/output devices are discussed and compared. Software is the primary focus of the course. The main topics are system software (Windows, OS X, etc) and applications (such as browsers, word processors, spreadsheets, presentation graphics and database managers). The course concludes with discussions concerning legal and ethical issues surrounding computer technology, management information systems, and systems analysis. Expected preparation: high school algebra.

CS 106 - Computing Fundamentals II (4)

Introduction to programming, appropriate for non-CS majors. Introduction to the logical thought processes and problem-solving strategies used when programming. Concepts presented include problem definition and requirements gathering, generating a description of a step-by-step solution (the algorithm), writing a program, testing, and documentation. The programming language Visual Basic is used; several programming projects are completed during the term. Expected preparation: high school algebra, knowledge of Windows and the ability to use Windows Explorer.

CS 107 - Computing Fundamentals III (4)

Introduction to Web programming and associated web tool usage for non-CS majors. Centering around the more sophisticated aspects of browsers. Web pages that represent the input to browsers are defined. In-depth study of HTML, VBScript and JavaScript. Brief exploration into CGI Scripts and other server-side tools. Course differentiates between Web page design (a graphics designer's role) and Web page programming, taking the results of their work and committing it to workable code. Recommended prerequisites: high school algebra and CS106 or some programming experience.

CS 161 - Introduction to Programming and Problem-Solving (4)

Introduction to fundamental concepts of computer science. Problem solving, algorithm and program design, data types, loops, control structures, subprograms, and arrays. Learn to write programs in a high level programming language. Surveys current social and ethical aspects of computer science. Recommended prerequisite: Mth 111Z.

CS 161L - Introduction to Programming and Problem-Solving Laboratory (0)

Lab for CS 161 Introduction to Programming and Problem-Solving.

CS 162 - Introduction to Computer Science (4)

The goals of this class are to teach the syntax of C++ to students who already know how to program. Students are expected to be proficient at using conditionals, I/O, loops, and functions with arguments. Topics include: conditionals, I/O, files, functions, classes, pointers, dynamic memory, linear linked lists, and multi-dimensional arrays in C++, as well as program correctness, verification, and testing. Three hours lecture and one 3-hour laboratory. The laboratory emphasizes practical programming skills.

Prerequisite: CS 161.

CS 162L - Lab for CS 162 (0)

Lab for CS 162.

Corequisite: CS 162.

CS 163 - Data Structures (4)

Data abstraction with formal specification. Elementary algorithm analysis. Basic concepts of data and its representation inside a computer. Linear, linked, and orthogonal lists; tree structures. Data structures are implemented as data abstractions using pointer based implementations. Sorting and search strategies. Data management. Three hours lecture and one 3-hour laboratory. The laboratory emphasizes practical programming skills.

Prerequisite: CS 162 with a grade of C or better. Co-requisites: concurrent enrollment in CS163L. Corequisite: CS 163L.

CS 163L - Lab for CS 163 (0)

Lab for CS 163.

Corequisite: CS 163.

CS 199 - Special Studies (0-12)

(Credit to be arranged.)

CS 205 - System Programming and Architecture (4)

Introduction to computer systems from a software perspective. Topics include: 1) Basic machine organization, 2) System programming using C and assembly language, 3) System tools such as compilers and debuggers, 4) Data representation (bits bytes, characters, integers, floating point numbers), 5) Implementation of control flow, procedure calls, and complex data types at machine level, 6) Improving program performance, and 7) Introduction to memory hierarchy.

Prerequisite: CS 162.

CS 250 - Discrete Structures I (4)

Introduces discrete structures and techniques for computing. Sets. Graphs and trees. Functions: properties, recursive definitions. Relations: properties, equivalence, partial order. Proof techniques, inductive proof. Counting techniques and discrete probability.

Prerequisite: CS 161 and Mth 112Z or passing at the necessary level on the mathematics placement test within the last year.

CS 251 - Discrete Structures II (4)

Continuation of CS 250. Logic: propositional calculus, first-order predicate calculus. Formal reasoning: natural deduction, resolution. Applications to program correctness and automatic reasoning. Introduction to algebraic structures in computing.

Prerequisite: CS 250.

CS 299 - Special Studies (0-4)

(Credit to be arranged.)

CS 299L - Lab for CS 299 (0)

Lab for CS 299.

CS 302 - Programming Methodologies and Software Implementation (4)

Introduces principles and techniques for producing high-quality software solutions to computational problems using modern programming languages. Important topics include: analysis of informal specifications and documentation; unit testing; abstract data types; object-oriented and functional programming design techniques; and use of software libraries. Laboratory exercises will include application of contemporary software tools, including integrated development environments, debuggers, version control, and build frameworks.

Prerequisite: CS 163, CS 205, CS 250. Corequisite: CS 302L.

CS 302L - Lab for CS 302 (0)

Lab for CS 302L.

Corequisite: CS 302.

CS 305 - Social, Ethical, and Legal Implications of Computing (2)

History of computing, social context of computing, professional and ethical responsibilities, risks and liabilities of safety-critical systems, intellectual property, privacy and civil liberties, social implications of the Internet, computer crime, economic issues in computing.

Prerequisite: a course in computer science at the 300 or higher level. Sophomore inquiry or a course in public speaking and a course in writing a research paper.

CS 311 - Computational Structures (4)

Introduces the foundations of computing. Regular languages and finite automata. Context free languages and pushdown automata. Turing machines and equivalent models of computation. Computability. Introduction to complexity. An appropriate programming language is used for programming experiments.

Prerequisite: CS 251.

CS 313 - Artificial Intelligence and Game Design (4)

Study of the basic principles of computer game design, the most popular techniques and technologies for game implementation, focusing on the many ways in which advances in artificial intelligence influences game design.

Prerequisite: Prior computer programming experience equivalent to CS 163.

CS 314 - Elements of Software Engineering (4)

Practical techniques of program development for medium-scale software produced by individuals. Software development from problem specification through design, implementation, testing, and maintenance. The fundamental design techniques of step-wise refinement and data abstraction. A software project will be carried through the development cycle.

Prerequisite: CS 302.

CS 333 - Introduction to Operating Systems (4)

Introduction to the principles of operating systems and concurrent programming. Operating system services, file systems, resource management, synchronization. The concept of a process; process cooperation and interference. Introduction to networks, and protection and security. Examples drawn from one or more modern operating systems. Programming projects, including concurrent programming.

Prerequisite: CS 302.

CS 333L - Introduction to Operating Systems Lab (0)

Lab for Introduction to Operating Systems.

Corequisite: CS 333.

CS 340 - Discrete Structures for Engineers (4)

A one-term introduction to discrete structures with applications to computing problems. Topics include sets, relations, functions, counting, graphs, trees, recursion, propositional and predicate logic, proof techniques, Boolean algebra. The course may not be used as part of the degree requirements for the BS degree in Computer Science.

Prerequisite: CS 163, Math 252.

CS 345 - Cyberculture: The Internet and Popular Culture (4)

Study of the effect of computers and the internet on popular culture. Graduates of the course will become more intelligent and successful users of the Internet, understand how the internet works, be aware of the wide variety of applications that exist on the internet, and will understand the primary principles that underlie the success the Internet has had in changing popular culture. Typical topics will include history and technologies of the web, social

networks, the long tail in business and culture, the power of groups, user generated content, complex systems, virtual worlds and the power of search.

Prerequisite: Sophomore Inquiry: Popular Culture (UNST 254).

CS 345 - Cyberculture: The Internet and Popular Culture (4)

Study of the effect of computers and the internet on popular culture. Graduates of the course will become more intelligent and successful users of the Internet, understand how the internet works, be aware of the wide variety of applications that exist on the internet, and will understand the primary principles that underlie the success the Internet has had in changing popular culture. Typical topics will include history and technologies of the web, social networks, the long tail in business and culture, the power of groups, user generated content, complex systems, virtual worlds and the power of search.

CS 346U - Exploring Complexity in Science and Technology (4)

Introduction to Complex Systems, an interdisciplinary field that studies how collections of simple entities organize themselves to produce complex behavior, use information, and adapt and learn. Focuses on common principles underlying complexity in science and technology, and includes ideas from physics, biology, the social sciences, and computer science. The course may not be used as one of the upper-division CS Electives for the BS degree in Computer Science. This course is the same as SySc 346; course may be taken only once for credit.

Cross-Listed as: SySc 346U.

CS 347U - The Internet Age (4)

Examination of the Internet and its evolution over the last 30 years to become an essential part of today's society. Also examines the impact the Internet has had on society as well as potential threats to its continued success. The course may not be used as one of the upper-division CS Electives for the BS degree in Computer Science.

CS 348U - Digital Media, Technology and Society (4)

Covers, from a computing perspective, the transition of society to one that is primarily digital. Provides an understanding of digital media, its technical limitations, copyright and digital rights management, and digital media communications. The course may not be used as an upper-division CS Elective for the BS degree in Computer Science.

CS 350 - Algorithms and Complexity (4)

Techniques for the design and analysis of algorithms. Case studies of existing algorithms (sorting, searching, graph algorithms, dynamic programming, matrix multiplication, fast Fourier transform.) NP-Completeness.

Prerequisite: CS 163, CS 250, Mth 251.

CS 358 - Principles of Programming Languages (4)

Syntax and semantics. Compilers and interpreters. Programs as data. Regular expressions and context free grammars. Programming paradigms, including procedural, functional, and object-oriented programming. Type systems, including dynamic and static typing disciplines. Binding, scope, data abstraction, and modularity. Denotational, operational, and axiomatic semantics. Introduction to program correctness.

Prerequisite: CS 302, CS 314, and CS 350.

CS 399 - Special Studies (0-6)

(Credit to be arranged.) Consent of instructor.

CS 399L - Lab for CS 399 (0)

Lab for CS 399 special studies.

CS 399P - Special Studies (1-6)
(Credit to be arranged.)

CS 401 - Research (1-6)
(Credit to be arranged.) Consent of instructor.

CS 402 - Independent Study (1-12)
(Credit to be arranged.)

CS 403 - Honors Thesis (1-4)
(Credit to be arranged.) Consent of instructor.

CS 404 - Cooperative Education/Internship (1-12)
(Credit to be arranged.) Consent of instructor.

CS 405 - Reading and Conference (1-6)
(Credit to be arranged.) Consent of instructor.

CS 406 - Special Projects (1-6)
(Credit to be arranged.) Consent of instructor.

CS 407 - Seminar (1-6)
(Credit to be arranged.) Consent of instructor.

CS 409 - Practicum (1-9)
(Credit to be arranged.) Consent of instructor.

CS 410 - Selected Topics (1-6)
(Credit to be arranged.) Consent of instructor.

CS 410L - Selected Topics Lab (0)
Lab for CS 410.

CS 410P - Selected Topics (1-6)
Programming intensive version of CS 410. (Credit to be arranged.) Consent of instructor.

CS 415 - Parallel Programming (4)

An introduction to parallel programming concepts and techniques. Topics include: parallel programming models and languages, share-memory programming, message-passing programming, performance models and analysis techniques, domain-specific parallel algorithms.

Also offered for graduate-level credit as CS 515 and may be taken only once for credit. . Prerequisite: CS 302 and CS 333.

CS 415L - Lab for CS 415P (0)

Lab for CS 415P Parallel Programming.

Corequisite: CS 415P.

CS 415P - Parallel Programming (4)

An introduction to parallel programming concepts and techniques. Topics include: parallel programming models and languages, share-memory programming, message-passing programming, performance models and analysis techniques, domain-specific parallel algorithms.

Prerequisite: CS 302 and CS 333. Corequisite: CS 415L.

CS 418 - Cultural Competence in Computing (4)

Students will learn about different identities (e.g., race, ethnicity, gender, class, sexuality, and ability), understand how algorithmic bias in technology affects different identities, and learn how to create accessible and equitable products and more inclusive communities at school, in industry, and beyond.

Also offered for graduate level credit as CS 518 and may be taken only once for credit. Prerequisite: Admission to the program.

CS 420 - Object-Oriented Programming and Design (4)

The fundamental concepts of object-oriented programming, including object-oriented modeling and design. The focus of the course will be to help students create programs that model their application domain, that exhibit that model to other programmers who read the code, and that are as a consequence maintainable and robust to change. Issues addressed may include data abstraction and modeling, the use and misuse of inheritance, higher-order data structures and their operations, reusability, refactoring, concurrency control, and usability. Includes programming assignments in an OO language.

Also offered for graduate-level credit as CS 520 and may be taken only once for credit. . Prerequisite: CS 358.

CS 420P - Object-Oriented Programming (4)

The fundamental concepts of object-oriented programming languages, including data abstraction and typing, class inheritance and generic types, prototypes and delegation, concurrency control and distribution, object-oriented databases, and implementation. To illustrate these issues, programming assignments in languages such as Smalltalk, Eiffel and C++ will be given.

Prerequisite: CS 358.

CS 421 - Programming Language Implementation: Syntax and Static Semantics (4)

Techniques and tools for construction of compiler and interpreter front-ends, including: representation of programs using abstract syntax trees; lexical analysis, and lexer generators; parsing (recursive descent, top-down, and bottom-up), and parser generators; type checking and static analysis. Design and implementation of a front-end for a small programming language.

Prerequisite: CS 205, CS 302, CS 314, and CS 358.

CS 421L - Lab for CS 421 (0)

Lab for CS 421.

CS 421P - Programming Language Implementation: Syntax and Static Semantics (4)

Techniques and tools for construction of compiler and interpreter front-ends, including: representation of programs using abstract syntax trees; lexical analysis, and lexer generators; parsing (recursive descent, top-down, and bottom-up), and parser generators; type checking and static analysis. Design and implementation of a front-end for a small programming language.

Prerequisite: CS 205, CS 302, CS 311, CS 314, and CS 358.

CS 422 - Programming Language Implementation: Code Generation and Dynamic Semantics (4)

Techniques and tools for construction of compiler and interpreter back-ends, including: interpreter design; code generation strategies for standard programming constructs; intermediate representations; optimization techniques; run-time organization, including functions, objects, and closures; run-time systems. Design and implementation of an interpreter and a compiler back-end for a small programming language.

Prerequisite: CS 205, CS 302, CS 311, CS 314, and CS 358.

CS 422L - Lab for CS 422 (0)

Lab for CS 422.

CS 422P - Programming Language Implementation: Code Generation and Dynamic Semantics (4)

Techniques and tools for construction of compiler and interpreter back-ends, including: interpreter design; code generation strategies for standard programming constructs; intermediate representations; optimization techniques; run-time organization, including functions, objects, and closures; run-time systems. Design and implementation of an interpreter and a compiler back-end for a small programming language.

Prerequisite: CS 205, CS 302, CS 314, and CS 358.

CS 430P - Internet, Web, & Cloud Systems (4)

Covers modern networked computing systems and the abstractions they provide. Specifically, students will learn about and apply their knowledge of topics such as Internet protocols, virtual machines and containers, web servers and frameworks, and databases as well as their deployment in modern cloud environments.

Also offered for graduate-level credit as CS 530 and may be taken only once for credit. Prerequisite: Upper-division standing and admission into the CS program.

CS 431 - Introduction to Performance Measurement, Modeling and Analysis (4)

A survey of the fundamentals of computer application and system performance. Hands on programming exercises will allow us to apply the techniques to increasingly complex problems. We will use a variety of state of the art tools for measurement, modeling, simulation, and analysis throughout the course.

Also offered for graduate-level credit as CS 531 and may be taken only once for credit. Prerequisite: CS 205 and CS 302 and CS 333.

CS 435 - Accelerated Computing (4)

Heterogeneous approaches that use special-purpose processors to accelerate the execution of a variety of applications. GPUs, Intel Xeon Phi, APUs, FPGUs. The sustainability implications of these platforms. Lectures, homeworks, labs, and group programming projects using NVIDIA GPUs and Intel Xeon Phi.

Also offered for graduate-level credit as CS 535 and may be taken only once for credit. Prerequisite: CS 333.

CS CS 435L - Lab for CS 435 (0)

Lab for CS 435.

Corequisite: CS 435.

CS 438 - Computer Architecture (4)

Processors, memory hierarchy, and bus systems. Multi-level caches and cache coherence in MP systems. Arithmetic algorithms. RISC vs. CISC instructions, pipelining, and software pipelining. Superscalar, super pipelined, and

VLIW architectures. Connection networks. Performance evaluation, simulation, and analytic models. Performance enhancement through branch prediction and out-of-order execution.

Also offered for graduate-level credit as CS 538 and may be taken only once for credit. . Prerequisite: CS 333.

CS 440 - Deep Learning: Computational Structures and Programming (4)

Deep learning is a powerful tool for machine learning systems. This class provides an introduction to this topic and will focus on classic as well as emerging deep learning techniques. Topics studied include multi-layer perceptrons, convolution neural networks, long-short term memory, attention mechanisms, autoencoders, generative adversarial networks, and natural language models. The class will focus on learning concepts and applying them via several programming assignments.

Also offered for graduate-level credit as CS 540 and may be taken only once for credit. Prerequisite: CS 350.

CS 441 - Artificial Intelligence (4)

Introduction to the basic concepts and techniques of artificial intelligence. Knowledge representation, problem solving, machine learning, natural language understanding, and AI search techniques.

Also offered for graduate-level credit as CS 541 and may be taken only once for credit. . Prerequisite: CS 302.

CS 442 - Advanced Artificial Intelligence: Combinatorial Games (4)

Covers the theory and practice of finding optimal and satisfying solutions to one-player and two-player combinatorial games, including such popular games as Sokoban, Othello, checkers, chess, backgammon, bridge, and CCGs. Simple applications in decision theory and economics may also be discussed. Emphasis on implementation of state-of-the-art solution techniques.

Also offered for graduate-level credit as CS 542 and may be taken only once for credit. . Prerequisite: CS 302 or experience with algorithms and data structures.

CS 442P - Advanced Artificial Intelligence: Combinatorial Games (4)

Covers the theory and practice of finding optimal and satisfying solutions to one-player and two-player combinatorial games, including such popular games as Sokoban, Othello, checkers, chess, backgammon, bridge, and CCGs. Simple applications in decision theory and economics may also be discussed. Emphasis on implementation of state-of-the-art solution techniques.

Prerequisite: CS 302 or experience with algorithms and data structures.

CS 443 - Advanced Artificial Intelligence: Combinatorial Search (4)

Explores methods for the solution of constraint satisfaction and related problems using search techniques, in the context of real-world problems such as resource-bounded scheduling, enterprise planning, classical planning, and one- and two-player games. Emphasis on coding projects, and on reading and reporting on selected literature.

Also offered for graduate-level credit as CS 543 and may be taken only once for credit. . Prerequisite: CS 302 or experience with algorithms and data structures.

CS 445 - Machine Learning (4)

Provides a broad introduction to techniques for building computer systems that learn from experience; conceptual grounding and practical experience with several learning systems; and grounding for advanced study in statistical learning methods, and for work with adaptive technologies used in speech and image processing, robotic planning and control, diagnostic systems, complex system modeling, and iterative optimization. Students gain practical experience implementing and evaluating systems applied to pattern recognition, prediction, and optimization problems.

Also offered for graduate-level credit as CS 545 and may be taken only once for credit. . Prerequisite: Mth 261 OR Mth 343; CS 302.

CS 446 - Advanced Topics in Machine Learning (4)

Covers a number of more advanced topics in machine learning from a more mathematically oriented view. Provides preparation for successfully using machine-learning techniques for various applications. Also provides preparation for graduate-level research in machine learning and adaptive systems.

Also offered for graduate-level credit as CS 546 and may be taken only once for credit. . Prerequisite: CS 445/545.

CS 447 - Computer Graphics (4)

This course will provide an introduction to graphics systems and applications. Basic structure of interactive graphics systems, characteristics of various hardware devices. Control of display devices, implementation of simple packages, device independence, and standard packages. Distributed architectures for graphics, hidden line and hidden surfaces algorithms, representations of curves and surfaces.

Also offered for graduate-level credit as CS 547 and may be taken only once for credit. . Prerequisite: CS 302, Mth 261.

CS 447P - Computer Graphics (4)

This course will provide an introduction to graphics systems and applications. Basic structure of interactive graphics systems, characteristics of various hardware devices. Control of display devices, implementation of simple packages, device independence, and standard packages. Distributed architectures for graphics, hidden line and hidden surfaces algorithms, representations of curves and surfaces.

Prerequisite: CS 302, Mth 261.

CS 451 - Numerical Computation (4)

Introduction to numerical methods. Includes topics from elementary discussion of errors, polynomials, interpolation, quadrature, linear systems of equations, and solution of nonlinear equations.

Also offered for graduate-credit as CS 551 and may be taken only once for credit. . Prerequisite: Mth 261.

CS 452 - Building Software Systems with Components (4)

Designed to familiarize students with the concepts behind and opportunities afforded by modern component architectures, such as Microsoft COM, Java Beans, and CORBA. Students are exposed to component development techniques and methods for developing complex software architectures using components. Students become familiar with component development, scripting and composing components, and the strengths and weaknesses of using components in designing large complex software systems.

Also offered for graduate-level credit as CS 552 and may be taken only once for credit. . Prerequisite: CS 314, CS 333, CS 350; knowledge of C++ or Java programming.

CS 454 - Software Engineering (4)

Current methodologies for the development of large, industrial strength software systems. Topics include requirements, specification, design, implementation, testing, project management and cost estimation, formal methods, and software process improvement.

Also offered for graduate-level credit as CS 554 and may be taken only once for credit. . Prerequisite: CS 302, CS 314, and CS 358.

CS 457 - Functional Programming (4)

Introduction to functional notation, recursion, higher-order functions, reasoning about functions, and models for the evaluation of applicative expressions. Use of functional languages.

Also offered for graduate-level credit as CS 557 and may be taken only once for credit. . Prerequisite: CS 302.

CS 461 - Open Source Software Development Laboratory (4)

Explores Open Source software engineering and its methodologies in a laboratory classroom setting. Focuses on the development and delivery of Open Source software projects by teams of 1-3 students. Students prepare and present material, working using email and the web.

Also offered for graduate-level credit as CS 561 and may be taken only once for credit. . Prerequisite: CS 314.

CS 461P - Open Source Software Development Laboratory (4)

Explores Open Source software engineering and its methodologies in a laboratory classroom setting. Focuses on the development and delivery of Open Source software projects by teams of 1-3 students. Students prepare and present material, working using email and the web.

Prerequisite: CS 314.

CS 462 - Advanced Open Source Software Engineering (4)

Surveys the growing academic literature describing tools, techniques, community management, project management and collaboration strategies used in open source software development. Emphasis is placed upon tool-driven development, upon open development processes and tools, and upon comparison with processes and practices in proprietary software.

Also offered for graduate-level credit as CS 562 and may be taken only once for credit. . Prerequisite: CS 314.

CS 463 - Intro to Web Development (4)

Students will learn the fundamentals of web development, the structure and functionality of the web, and how to create responsive and accessible web applications using HTML, CSS, and JavaScript.

Also offered for graduate-level credit as CS 563 and may be taken only once for credit. Prerequisite: Admission to the program.

CS 464P - Front End Web Technologies (4)

Students will learn the languages, libraries, and frameworks needed to build user interfaces. This class will start with a review of HTML, CSS, and JavaScript, before focusing on React and the React ecosystem. Students will also work with CSS animations, gain experience with data visualization libraries, and learn about design principles and design systems. The final project is a dashboard application, which will leverage many of the topics covered in class and give students the opportunity to create a data-driven React application.

Also offered for graduate-level credit as CS 564 and may be taken only once for credit. Prerequisite: CS 463.

CS 465P - Full Stack Web Development (4)

This class provides an overview of how the web works and covers the spectrum of full stack web development, including using front-end and back-end frameworks to build accessible and responsive applications.

Also offered for graduate-level credit as CS 565 and may be taken only once for credit. . Prerequisite: CS 302, CS 463.

CS 466 - Voice Assistants (4)

Provides an introduction to voice technologies and how to design and build voice-enabled applications, by learning the concepts, techniques, and frameworks needed to build fully functional chatbots and virtual assistants. Students will explore the conversational design process and how to build effective voice user interfaces (VUIs) and conversational user interfaces (CUIs), and create voice-enabled applications and virtual assistants using popular APIs and platforms. Course assumes a working knowledge of JavaScript and Node.js or Python.

Also offered for graduate-level credit as CS 566 and may be taken only once for credit. Prerequisite: Admission to program.

CS 467 - The Wireless Web (4)

Covers the basics of the Wireless Application Protocol (WAP) as used in modern mobile phones and other handheld devices. Provides an overview of the WAP architecture, as well as an in-depth exploration of the WAP Application Layer (WAE), including WML, WMLScript, and the WAP push framework.

Also offered for graduate-level credit as CS 567 and may be taken only once for credit. Prerequisite: CS 465/565.

CS 469 - Software Engineering Capstone I (3)

Emphasizes teamwork on a substantial project that will be developed for a real customer. The course integrates the knowledge and skills from the rest of the CS curriculum. This course creates an obligation for participation for two consecutive quarters. This is the first course in a sequence of two CS 469, CS 470 and must be taken in sequence. Offered as P/NP only.

Prerequisite: CS 302, CS 314, CS 333, CS 350, CS 358, and at least one Programming intensive course.

CS 470 - Software Engineering Capstone II (3)

Emphasizes teamwork on a substantial project that will be developed for a real customer. The course integrates the knowledge and skills from the rest of the CS curriculum. This course creates an obligation for participation for two

consecutive quarters. This is the second course in a sequence of two CS 469, CS 470 and must be taken in sequence. Offered as P/NP only.

Prerequisite: CS 469.

CS 480 - Randomized Algorithms and Probabilistic Analysis (4)

Probabilistic tools used in the design and analysis of modern algorithms and data structures. Topics include: review discrete random, occupancy problems, tail bounds, Markov chains, the probabilistic method, martingales, Monte Carlo methods. The course explores a variety of CS applications.

Also offered for graduate-level credit as CS 580 and may be taken only once for credit. . Prerequisite: CS 350, Stats 451.

CS 485 - Cryptography (4)

The goal of cryptography is the encoding of information via a cryptographic system. Cryptanalysis studies the breaking of cryptosystems. This course focuses on cryptography but with respect to cryptanalysis. An overview of classical systems with an in-depth examination of modern cryptosystems. This includes block algorithms such as DES; public-key cryptosystems, such as RSA; and one-way functions. Additional topics include cryptographic protocols, signature schemes, pseudo-random number generation, Shannon's information theory, and stream ciphers.

Also offered for graduate-level credit as CS 585 and may be taken only once for credit. . Prerequisite: CS 350.

CS 486 - Introduction to Database Management Systems (4)

Introduction to fundamental concepts of database management systems using primarily the relational model. Schema design and refinement. Query languages. Database application development environments. Overview of physical data organization, query optimization and processing, physical design, security, and transactions used in recovery and concurrency control. Expected preparation: CS 251.

Also offered for graduate-level credit as CS 586 and may be taken only once for credit. . Prerequisite: CS 161 and CS 250.

CS 487 - Database Management Systems Implementation (4)

Internal design of a relational database management system. Concurrency control; lock managers; crash recovery; query and operator evaluation; query optimization; storage management; index structures; system catalogs.

Also offered for graduate-level credit as CS 587 and may be taken only once for credit. . Prerequisite: CS 486 and CS 333.

CS 487P - Database Management Systems Implementation (4)

Internal design of a relational database management system. Concurrency control; lock managers; crash recovery; query and operator evaluation; query optimization; storage management; index structures; system catalogs.

Prerequisite: CS 486 and CS 333.

CS 488P - Cloud and Cluster Data Management (4)

Covers advanced data management solutions emerging for cloud and cluster computing environments, focusing on horizontal and vertical scalable approaches. Also covers principles behind data management in these environments, plus specific data management systems that are currently in use or being developed. Topics range from novel data processing paradigms to commercial data management platforms and open-source NoSQL databases. Students will gain broad knowledge about these systems and practical experience with them.

Also offered for graduate-level credit as CS 588 and may be taken only once for credit. Prerequisite: CS 486 or consent of the instructor.

CS 489 - Blockchain Development & Security (4)

Overview of blockchain systems, how they are built, and how they can be exploited. Students will get hands-on experience working with public blockchains as well as build and deploy permissioned blockchains. They will then examine security vulnerabilities in blockchain systems and how they may be automatically exploited.

Also offered for graduate-level credit as CS 589 and may be taken only once for credit. Prerequisite: Upper-division standing.

CS 490 - Introduction to Multimedia Computing and Networking (4)

Introductory course in multimedia computing and networking intended for senior undergraduate or graduate level students. The objective of this course is to introduce many of the fundamental concepts involved with handling multimedia data and applications. The course will cover (i) basic representation and compression of multimedia data types including H.261, JPEG, and MPEG, (ii) techniques to support multimedia quality-of-service in computing and networked systems, and (iii) networked streaming media techniques such as buffering and adaptation.

Also offered for graduate-level credit as CS 590 and may be taken only once for credit. Prerequisite: CS 333 or instructor's permission. .

CS 491 - Introduction to Computer Security (4)

Provides a broad overview of computer security. Introduces foundational principles and shows how they are applied to secure real computing systems. Covers how cryptography, access control, and authentication support confidentiality, integrity, and availability when applied to networks, hosts, information, software, applications, and users.

Also offered for graduate-level credit as CS 591 and may be taken only once for credit. . Prerequisite: CS 205.

CS 492 - Malware Reverse Engineering (4)

Studies the techniques malicious code developers employ to exploit vulnerable computer systems. The course explores the form and function of a range of malware while exploring how the increased mixing of code and data is now exposing us to an array of security vulnerabilities and exploits. Given these threats, the course will then examine modern defenses against malware and how they can be used to protect users.

Also offered for graduate-level credit as CS 592 and may be taken only once for credit. . Prerequisite: Junior-standing and admission into the CS program.

CS 493 - Digital Forensics (4)

Detailed, hands-on approach to the investigation of criminal incidents in which computers or computer technology play a significant or interesting role. Familiarization with the core computer science theory and practical skills necessary to perform rudimentary computer forensic investigations, understanding the role of technology in investigating computer-based crime, and preparation to deal with investigative bodies. Recommended: CS 333 or CS 533. No prior background in criminal justice or law is assumed.

Also offered for graduate-level credit as CS 593 and may be taken only once for credit. .

CS 494 - Internetworking Protocols (4)

Advanced study of the protocols and algorithms used in the Internet (IETF) family of networking protocols. For example, ARP, IP, UDP, TCP, multicasting, routing protocols like RIP and OSPF, and application protocols like DNS, NFS, SNMP, FTP and HTTP. Issues such as addressing, name service, protocol design, and scalability will be explored.

Also offered for graduate-level credit as CS 594 and may be taken only once for credit. . Prerequisite: CS 333.

CS 494P - Internetworking Protocols (4)

Advanced study of the protocols and algorithms used in the Internet (IETF) family of networking protocols. For example, ARP, IP, UDP, TCP, multicasting, routing protocols like RIP and OSPF, and application protocols like DNS, NFS, SNMP, FTP and HTTP. Issues such as addressing, name service, protocol design, and scalability will be explored.

Prerequisite: CS 333.

CS 495 - Web and Cloud Security (4)

Covers web and cloud systems and how they can be subverted. The class will focus on the highest risk vulnerabilities, give students practical experience in how they work, and study how they can be prevented. The class will consist mostly of laboratory exercises focused on developing student skills in performing penetration testing.

Also offered for graduate-level credit as CS 595 and may be taken only once for credit. Prerequisite: CS 205.

CS 496 - Network Security (4)

Focus on network security including a review of various forms of network attacks; a review of basic techniques in applied cryptography, and secure protocols will be covered including network-layer security and various application-layer secure protocols. Also covers network-side security management including both passive measures, as well as active intrusion detection and response. Covers protocols for protection of privacy and anonymity.

Also offered for graduate-level credit as CS 596 and may be taken only once for credit. Prerequisite: CS 205.

CS 497 - Sensor Networks (4)

Foundations of sensor networks, with a focus on activity-based learning through a sequence of hands-on programming exercises with embedded devices with a high-level programming language. Basic building blocks in designing and deploying a sensor network application. Positioning and time synchronization of networked sensor devices, wireless communication characteristics of low-powered radios, energy conservation and harvesting, macro-programming a network of sensor devices and security. Recommended prerequisites: Familiarity with computer systems concepts that could be satisfied by CS 205. Familiarity with programming in C, C++ or Java. Familiarity with basic concepts in probability and linear algebra that could be satisfied by Mth 301 or equivalent.

Also offered for graduate-level credit as CS 597 and may be taken only once for credit. .

CS 498 - Introduction to Wireless Network Protocols (4)

Classification of wireless networking systems; study of multiple access protocols in single hop and multi-hop networks; performance analysis of protocols; overview of emerging radio technologies for high-throughput next generation systems; study of wireless communication protocol standards for cellular systems; case studies of deployed systems.

Also offered for graduate-level credit as CS 598 and may be taken only once for credit. . Prerequisite: CS 250 or ECE 271.

CS 501 - Research (1-9)

(Credit to be arranged.) Consent of instructor.

CS 502 - Independent Study (1-9)

(Credit to be arranged.)

CS 503 - Thesis (1-9)

(Credit to be arranged.) Consent of instructor.

CS 504 - Cooperative Education/Internship (1-9)

(Credit to be arranged.) Consent of instructor.

CS 505 - Reading and Conference (1-12)

(Credit to be arranged.) Consent of instructor.

CS 506 - Special Projects (1-9)

(Credit to be arranged.) Consent of instructor.

CS 507 - Seminar (1-6)

(Credit to be arranged.) Consent of instructor.

CS 509 - Practicum (1-9)

(Credit to be arranged.) Consent of instructor.

CS 510 - Selected Topics (1-6)

(Credit to be arranged.) Consent of instructor.

CS 515 - Parallel Programming (3)

An introduction to parallel programming concepts and techniques. Topics include: parallel programming models and languages, share-memory programming, message-passing programming, performance models and analysis techniques, domain-specific parallel algorithms.

Also offered for undergraduate-level credit as CS 415 and may be taken only once for credit. . Corequisite: CS 515L.

CS 515L - Lab for CS 515P (0)

Lab for CS 515P Parallel Programming.

Corequisite: CS 515.

CS 518 - Cultural Competence in Computing (3)

Students will learn about different identities (e.g., race, ethnicity, gender, class, sexuality, and ability), understand how algorithmic bias in technology affects different identities, and learn how to create accessible and equitable products and more inclusive communities at school, in industry, and beyond.

Also offered for undergraduate level credit as CS 418 and may be taken only once for credit. Prerequisite: Admission to the program.

CS 520 - Object-Oriented Programming & Design (3)

The fundamental concepts of object-oriented programming, including object-oriented modeling and design. The focus of the course will be to help students create programs that model their application domain, that exhibit that model to other programmers who read the code, and that are as a consequence maintainable and robust to change. Issues addressed may include data abstraction and modeling, the use and misuse of inheritance, higher-order data structures and their operations, reusability, refactoring, concurrency control, and usability. Includes programming assignments in an OO language.

Also offered for undergraduate-level credit as CS 420 and may be taken only once for credit. . Prerequisite: CS 553.

CS 530 - Internet, Web, & Cloud Systems (3)

Covers modern networked computing systems and the abstractions they provide. Specifically, students will learn about and apply their knowledge of topics such as Internet protocols, virtual machines and containers, web servers and frameworks, and databases as well as their deployment in modern cloud environments.

Also offered for graduate-level credit as CS 430P and may be taken only once for credit. Prerequisite: Graduate-standing and admission into CS program.

CS 531 - Introduction to Performance Measurement, Modeling and Analysis (3)

A survey of the fundamentals of computer application and system performance. Hands on programming exercises will allow us to apply the techniques to increasingly complex problems. We will use a variety of state of the art tools for measurement, modeling, simulation, and analysis throughout the course.

Also offered for undergraduate-level credit as CS 431 and may be taken only once for credit. Prerequisite: Graduate standing; CS 333 or an equivalent introductory course in Operating Systems.

CS 532 - Operating System Foundations (3)

Foundational concepts of operating system design including processes, threads, scheduling, concurrent programming, synchronization mechanisms, memory management, virtual address translation, file systems and security. A primary goal of the course is to help graduate students acquire the foundational knowledge necessary to succeed in CS 533.

CS 533 - Concepts of Operating Systems (3)

Survey of concepts and techniques used in modern operating systems. Sample concepts covered are concurrency, IPCs, scheduling, resource allocation, memory management, file systems, and security. Techniques for implementing operating systems taught through a programming project.

Prerequisite: CS 333 or CS 532.

CS 535 - Accelerated Computing (3)

Heterogeneous approaches that use special-purpose processors to accelerate the execution of a variety of applications. GPUs, Intel Xeon Phi, APUs, FPGUs. The sustainability implications of these platforms. Lectures, homeworks, labs, and group programming projects using NVIDIA GPUs and Intel Xeon Phi.

Also offered for undergraduate-level credit as CS 435 and may be taken only once for credit.

CS 538 - Computer Architecture (3)

Processors, memory hierarchy, and bus systems. Multi-level caches and cache coherence in MP systems. Arithmetic algorithms. RISC vs. CISC instructions, pipelining, and software pipelining. Superscalar, super pipelined, and VLIW architectures. Connection networks. Performance evaluation, simulation, and analytic models. Performance enhancement through branch prediction and out-of-order execution.

Also offered for undergraduate-level credit as CS 438 and may be taken only once for credit. .

CS 540 - Deep Learning: Computational Structures and Programming (3)

Deep learning is a powerful tool for machine learning systems. This class provides an introduction to this topic and will focus on classic as well as emerging deep learning techniques. Topics studied include multi-layer perceptrons, convolution neural networks, long-short term memory, attention mechanisms, autoencoders, generative adversarial networks, and natural language models. The class will focus on learning concepts and applying them via several programming assignments.

Also offered for undergraduate-level credit as CS 440 and may be taken only once for credit.

CS 541 - Artificial Intelligence (3)

Introduction to the basic concepts and techniques of artificial intelligence. Knowledge representation, problem solving, machine learning, natural language understanding, and AI search techniques.

Also offered for undergraduate-level credit as CS 441 and may be taken only once for credit. .

CS 542 - Advanced Artificial Intelligence: Combinatorial Games (3)

Covers the theory and practice of finding optimal and satisfying solutions to one-player and two-player combinatorial games, including such popular games as Sokoban, Othello, checkers, chess, backgammon, bridge, and CCGs. Simple applications in decision theory and economics may also be discussed. Emphasis on implementation of state-of-the-art solution techniques.

Also offered for undergraduate-level credit as CS 442 and may be taken only once for credit. . Prerequisite: Experience with algorithms and data structures.

CS 543 - Advanced Artificial Intelligence: Combinatorial Search (3)

Explores methods for the solution of constraint satisfaction and related problems using search techniques, in the context of real-world problems such as resource-bounded scheduling, enterprise planning, classical planning, and one- and two-player games. Emphasis on coding projects, and on reading and reporting on selected literature.

Also offered for undergraduate-level as CS 443 and may be taken only once for credit. Prerequisite: Experience with algorithms and data structures.

CS 545 - Machine Learning (3)

Provides a broad introduction to techniques for building computer systems that learn from experience; conceptual grounding and practical experience with several learning systems; and grounding for advanced study in statistical learning methods, and for work with adaptive technologies used in speech and image processing, robotic planning and control, diagnostic systems, complex system modeling, and iterative optimization. Students gain practical experience implementing and evaluating systems applied to pattern recognition, prediction, and optimization problems.

Also offered as undergraduate-level credit as CS 445 and may be taken only once for credit.

CS 546 - Advanced Topics in Machine Learning (3)

Covers a number of more advanced topics in machine learning from a more mathematically oriented view. Provides preparation for successfully using machine-learning techniques for various applications. Also provides preparation for graduate-level research in machine learning and adaptive systems.

Also offered for undergraduate-level credit as CS 446 and may be taken only once for credit. . Prerequisite: CS 445/545.

CS 547 - Computer Graphics (3)

This course will provide an introduction to graphics systems and applications. Basic structure of interactive graphics systems, characteristics of various hardware devices. Control of display devices, implementation of simple packages, device independence, and standard packages. Distributed architectures for graphics, hidden line and hidden surfaces algorithms, representations of curves and surfaces.

Also offered for undergraduate-level credit as CS 447 and may be taken only once for credit. .

CS 549 - Computational Geometry (3)

Perspective and projective geometry. Analytic projective geometry, projective lines and projective planes. Projective transformations of lines and planes. Homogeneous coordinates. Applications to two-dimensional computer graphics. Conic sections in design.

Prerequisite: CS 163 and 451.

CS 550 - Parallel Algorithms (3)

Definition and nature of parallel computation. Parallel computation from the point of view of hardware/architecture, program/scheduling, and algorithms. Why and how parallel computation is different from serial computation. Examples to highlight the differences. Parallel algorithms in general: illustration of the most important features and techniques. Illustration of the limitations. A survey of major results, general form of results, limitations on speed-up.

Prerequisite: CS 350.

CS 551 - Numerical Computation (3)

Introduction to numerical methods. Includes topics from elementary discussion of errors, polynomials, interpolation, quadrature, linear systems of equations, and solution of nonlinear equations.

Also offered for undergraduate-credit as CS 451 and may be taken only once for credit. .

CS 552 - Building Software Systems with Components (3)

Designed to familiarize students with the concepts behind and opportunities afforded by modern component architectures, such as Microsoft COM, Java Beans, and CORBA. Students are exposed to component development techniques and methods for developing complex software architectures using components. Students become familiar with component development, scripting and composing components, and the strengths and weaknesses of using components in designing large complex software systems.

Also offered for undergraduate-level credit as CS 452 and may be taken only once for credit. . Prerequisite: CS 300, CS 333, CS 350; knowledge of C++ or Java programming.

CS 553 - Design Patterns (3)

Software design patterns are reusable solutions to recurring software problems. They capture successful experiences and convey expert insight and knowledge to less experienced developers. Course provides an in-depth view of

patterns using Java as the presentation language. Course is suitable to software architects and developers who are already well-versed in this language. In addition, it offers continuous opportunities for learning the most advanced features of the Java language and understanding some principles behind the design of its fundamental libraries.

Also offered as CS 653 and may be taken only once for credit. . Prerequisite: programming in Java and CS 520.

CS 554 - Software Engineering (3)

Current methodologies for the development of large, industrial strength software systems. Topics include requirements, specification, design, implementation, testing, project management and cost estimation, formal methods, and software process improvement.

Also offered for undergraduate-level credit as CS 454 and may be taken only once for credit. .

CS 555 - Software Specification and Verification (3)

Theoretical and practical aspects of the software development process or software lifecycle. Covers the first part of the cycle: formulating the external requirements, specifying what the software is to do, and the abstract design. Emphasis will be on the formal aspects of specification and verification.

Also offered as CS 655 and may be taken only once for credit.

CS 556 - Software Implementation and Testing (3)

Theoretical and practical aspects of the software development process or software lifecycle. Covers the second part of the cycle: detailed design, implementation in a programming language, testing, and maintenance. Emphasis will be on the technical aspects of software testing.

Also offered as CS 656 and may be taken only once for credit.

CS 557 - Functional Programming (3)

Introduction to functional notation, recursion, higher-order functions, reasoning about functions, and models for the evaluation of applicative expressions. Use of functional languages.

Also offered for undergraduate-level credit as CS 457 and may be taken only once for credit. . Prerequisite: Graduate-standing and admission into the CS program.

CS 558 - Programming Languages (3)

In-depth study of current and historical issues in the design, implementation, and application of programming languages. Topics range from basic to advanced. Areas include syntax, semantics, scoping, typing, abstraction, exceptions, and concurrency. Computational paradigms such as functional, logic, and/or object oriented are analyzed. Several "recent" programming languages used. Expected preparation: CS 320.

Also offered as CS 658 and may be taken only once for credit. .

CS 559 - Software Measurement and Models (3)

Survey, evaluation, and application of software measurement techniques and models. Particular emphasis on product metrics such as Software Science, Cyclomatic Complexity, and Function Points.

CS 560 - Human-Computer Interaction (3)

Introduction to the basic theory of human-computer interaction. Principles of human cognition and interface design, interface evaluation techniques. Several prototyping tools will be presented. A project is required.

CS 561 - Open Source Software Development Laboratory (3)

Explores Open Source software engineering and its methodologies in a laboratory classroom setting. Focuses on the development and delivery of Open Source software projects by teams of 1-3 students. Students prepare and present material, working using email and the web.

Also offered for undergraduate-level credit as CS 461 and may be taken only once for credit. .

CS 562 - Advanced Open Source Software Engineering (3)

Surveys the growing academic literature describing tools, techniques, community management, project management and collaboration strategies used in open source software development. Emphasis is placed upon tool-driven development, upon open development processes and tools, and upon comparison with processes and practices in proprietary software.

Also offered for undergraduate-level credit as CS 462 and may be taken only once for credit. .

CS 563 - Intro to Web Development (3)

Students will learn the fundamentals of web development, the structure and functionality of the web, and how to create responsive and accessible web applications using HTML, CSS, and JavaScript.

Also offered for undergraduate-level credit as CS 463 and may be taken only once for credit.

CS 564 - Front End Web Technologies (3)

Students will learn the languages, libraries, and frameworks needed to build user interfaces. This class will start with a review of HTML, CSS, and JavaScript, before focusing on React and the React ecosystem. Students will also work with CSS animations, gain experience with data visualization libraries, and learn about design principles and design systems. The final project is a dashboard application, which will leverage many of the topics covered in class and give students the opportunity to create a data-driven React application.

Also offered for undergraduate-level credit as CS 464P and may be taken only once for credit. Prerequisite: CS 563.

CS 565 - Full Stack Web Development (3)

This class provides an overview of how the web works and covers the spectrum of full stack web development, including using front-end and back-end frameworks to build accessible and responsive applications.

Also offered for undergraduate-level credit as CS 465P and may be taken only once for credit. . Prerequisite: CS 563.

CS 566 - Voice Assistants (3)

Provides an introduction to voice technologies and how to design and build voice-enabled applications, by learning the concepts, techniques, and frameworks needed to build fully functional chatbots and virtual assistants. Students will explore the conversational design process and how to build effective voice user interfaces (VUIs) and conversational user interfaces (CUIs), and create voice-enabled applications and virtual assistants using popular APIs and platforms. Course assumes a working knowledge of JavaScript and Node.js or Python.

Also offered for undergraduate-level credit as CS 466 and may be taken only once for credit.

CS 567 - The Wireless Web (3)

Covers the basics of the Wireless Application Protocol (WAP) as used in modern mobile phones and other handheld devices. Provides an overview of the WAP architecture, as well as an in-depth exploration of the WAP Application Layer (WAE), including WML, WMLScript, and the WAP push framework.

Also offered for undergraduate-level credit as CS 467 and may be taken only once for credit. . Prerequisite: CS 465/565.

CS 568 - Functional Logic Programming (3)

Introduction to functional logic programming. Foundations and basic principles of this paradigm will be explained in some depth and complemented by encoding practical problems in a functional logic language using a leading compiler/interpreter. Focus on non-determinism and computations with incomplete information. Implementation techniques will be briefly discussed.

Also offered as CS 668 and may be taken only once for credit. . Prerequisite: CS 558 Programming Languages.

CS 569 - Scholarship Skills for Computer Science and Engineering (3)

The purpose of this course is to make participants better scholars in Computer Science. In particular it attempts to help students become better researchers, better writers, better presenters, and better reviewers. It concentrates on reading, writing and composition skills: on the production and consumption of the "media" used by computer

scientists to communicate professionally. At the completion of the course, students should be familiar with the tasks and activities of modern scholars in computer science.

Also offered as CS 669 and may be taken only once for credit. . Prerequisite: admission into a Ph.D. program within MCECS.

CS 570 - Machine Learning Seminar (1)

Graduate seminar on machine learning. Students will read and discuss recent papers in the machine learning literature. This one-credit course will be offered each term, and students may take it multiple times.

Prerequisite: CS 445 or CS 545 or permission of instructor.

CS 572 - Operating System Internals (3)

Internals of a specific operating system including structure of the kernel, block buffering cache, file system structure and system calls, process structure and scheduling, memory management, device driver interface, and inter process communication.

Also offered as CS 672 and may be taken only once for credit. .

CS 575 - Computer Systems Analysis (3)

An advanced course on computer systems. Topics include operating systems, performance evaluation, device analysis, construction and proof of monitors, file systems, objects and processes, reliability, and protection.

Prerequisite: CS 333, Stat 460.

CS 576 - Computer Security Research Seminar (3)

Seminar on emerging topics in computer security.

Also offered as CS 676 and may be taken only once for credit. .

CS 577 - Modern Language Processors (3)

An advanced course on compiler construction for modern programming languages, such as object-oriented or functional languages. Topics include type-checking, executable intermediate representations, interpretation and virtual machines, code generation for modern architectures, memory management and garbage collection, and optimization.

Also offered as CS 677 and may be taken only once for credit. . Prerequisite: CS 421.

CS 578 - Programming Language Semantics (3)

Introduction to the formal mathematical study of program meaning (semantics), using one or more approaches such as operational semantics, denotational semantics, or programming logics. Emphasis on rigorous mathematical development and formal proof techniques. Language features to be studied may include types and type safety, purity and imperative effects, functional and modular abstraction, polymorphism, higher-order functions, and object-oriented features. Expected preparation: CS 558 and/or CS 557.

Also offered as CS 678 and may be taken only once for credit. .

CS 579 - Formal Verification of Hardware/Software Systems (3)

Introduction to the formal verification of functional correctness of hardware and software systems. Topics to be covered include: formal logics for system verification (first-order logic, higher order logic, temporal logic), formal specifications, theorem proving systems, circuit verification, microprocessor verification, and system software verification.

Prerequisite: CS 333.

CS 580 - Randomized Algorithms and Probabilistic Analysis (3)

Probabilistic tools used in the design and analysis of modern algorithms and data structures. Topics include: review discrete random, occupancy problems, tail bounds, Markov chains, the probabilistic method, martingales, Monte Carlo methods. The course explores a variety of CS applications.

Also offered for undergraduate-level credit as CS 480 and may be taken only once for credit. . Prerequisite: CS 350, Stats 451.

CS 581 - Theory of Computation (3)

Computability theory: study of models of computation (Turing, Church, Kleene), recursive function theory, properties of recursive, and recursively innumerable sets.

Prerequisite: CS 311.

CS 582 - Theory of Computation: Advanced Topics (3)

Complexity theory: study of resource bounded computation, the complexity classes (P, NP, PSPACE, and PH), NP-completeness, relativized computation, randomized classes.

Prerequisite: CS 311, 350.

CS 583 - Automata and Formal Languages (3)

An advanced study of the theory of automata, formal languages and computational complexity. Main subjects are finite state concepts, formal grammars, computability, Turing machines, and computational complexity.

Prerequisite: CS 582/682.

CS 584 - Algorithm Design and Analysis (3)

An advanced in-depth study in the design and analysis of algorithms. Topics include models of computation, sorting, data structures, graph algorithms, matrix multiplication, fast Fourier transform, polynomial arithmetic, pattern matching, and NP-complete problems.

Also offered as CS 684 and may be taken only once for credit. .

CS 585 - Cryptography (3)

The goal of cryptography is the encoding of information via a cryptographic system. Cryptanalysis studies the breaking of cryptosystems. This course focuses on cryptography but with respect to cryptanalysis. An overview of classical systems with an in-depth examination of modern cryptosystems. This includes block algorithms such as DES; public-key cryptosystems, such as RSA; and one-way functions. Additional topics include cryptographic protocols, signature schemes, pseudo-random number generation, Shannon's information theory, and stream ciphers.

Also offered for undergraduate-level credit as CS 485 and may be taken only once for credit. .

CS 586 - Introduction to Database Management Systems (3)

Introduction to fundamental concepts of database management systems using primarily the relational model. Schema design and refinement. Query languages. Database application development environments. Overview of physical data organization, query optimization and processing, physical design, security, and transactions used in recovery and concurrency control.

Also offered for undergraduate-level credit as CS 486 and may be taken only once for credit. .

CS 587 - Database Management Systems Implementation (3)

Internal design of a relational database management system. Concurrency control; lock managers; crash recovery; query and operator evaluation; query optimization; storage management; index structures; system catalogs.

Also offered for undergraduate-level credit as CS 487 and may be taken only once for credit. . Prerequisite: CS 486/586 and CS 333.

CS 588 - Cloud and Cluster Data Management (3)

Covers advanced data management solutions emerging for cloud and cluster computing environments, focusing on horizontal and vertical scalable approaches. It covers principles behind data management in these environments, plus specific data management systems that are currently in use or being developed. The topics range from novel data processing paradigms to commercial data management platforms and open-source NoSQL databases. Students will gain broad knowledge about these systems and practical experience with them.

Also offered for undergraduate-level credit as CS 488P and may be taken only once for credit. Prerequisite: CS 586 or consent of the instructor.

CS 589 - Blockchain Development & Security (3)

Overview of blockchain systems, how they are built, and how they can be exploited. Students will get hands-on experience working with public blockchains as well as build and deploy permissioned blockchains. They will then examine security vulnerabilities in blockchain systems and how they may be automatically exploited.

Also offered for undergraduate-level credit as CS 489 and may be taken only once for credit.

CS 590 - Introduction to Multimedia Computing and Networking (3)

Introductory course in multimedia computing and networking intended for senior undergraduate or graduate level students. The objective of this course is to introduce many of the fundamental concepts involved with handling multimedia data and applications. The course will cover (i) basic representation and compression of multimedia data types including H.261, JPEG, and MPEG, (ii) techniques to support multimedia quality-of-service in computing and networked systems, and (iii) networked streaming media techniques such as buffering and adaptation.

Also offered for undergraduate-level credit as CS 490 and may be taken only once for credit.

CS 591 - Introduction to Computer Security (3)

Provides a broad overview of computer security. Introduces foundational principles and shows how they are applied to secure real computing systems. Covers how cryptography, access control, and authentication support confidentiality, integrity, and availability when applied to networks, hosts, information, software, applications, and users.

Also offered for undergraduate-level credit as CS 491 and may be taken only once for credit. .

CS 592 - Malware Reverse Engineering (3)

Studies the techniques malicious code developers employ to exploit vulnerable computer systems. The course explores the form and function of a range of malware while exploring how the increased mixing of code and data is now exposing us to an array of security vulnerabilities and exploits. Given these threats, the course will then examine modern defenses against malware and how they can be used to protect users.

Also offered for undergraduate-level credit as CS 492 and may be taken only once for credit. . Prerequisite: Admission into the CS program.

CS 593 - Digital Forensics (3)

Detailed, hands-on approach to the investigation of criminal incidents in which computers or computer technology play a significant or interesting role. Familiarization with the core computer science theory and practical skills necessary to perform rudimentary computer forensic investigations, understanding the role of technology in investigating computer-based crime, and preparation to deal with investigative bodies. Recommended: CS 333 or CS 533. No prior background in criminal justice or law is assumed.

Also offered for undergraduate-level credit as CS 493 and may be taken only once for credit. .

CS 594 - Internetworking Protocols (3)

Advanced study of the protocols and algorithms used in the Internet (IETF) family of networking protocols. For example, ARP, IP, UDP, TCP, multicasting, routing protocols like RIP and OSPF, and application protocols like DNS, NFS, SNMP, FTP and HTTP. Issues such as addressing, name service, protocol design, and scalability will be explored.

Also offered for undergraduate-level credit as CS 494 and may be taken only once for credit. .

CS 595 - Web and Cloud Security (3)

Covers web and cloud systems and how they can be subverted. The class will focus on the highest risk vulnerabilities, give students practical experience in how they work, and study how they can be prevented. The class will consist mostly of laboratory exercises focused on developing student skills in performing penetration testing.

Also offered for undergraduate-level credit as CS 495 and may be taken only once for credit.

CS 596 - Network Security (3)

The class will focus on network security. In order to understand the network security problem, the course will include a review of various forms of network attacks. We will then review basic techniques in applied cryptography, and then secure protocols will be covered including network-layer security and various application-layer secure protocols. We then turn to network-side security management including both passive measures like firewall defense schemes including packet filers and bastion hosts, as well as active intrusion detection and response. Finally, we will cover protocols for protecting privacy and anonymity.

Also offered for undergraduate-level credit as CS 496 and may be taken only once for credit.

CS 597 - Sensor Networks (3)

Foundations of sensor networks, with a focus on activity-based learning through a sequence of hands-on programming exercises with embedded devices with a high-level programming language. Basic building blocks in designing and deploying a sensor network application. Positioning and time synchronization of networked sensor devices, wireless communication characteristics of low-powered radios, energy conservation and harvesting, macro-programming a network of sensor devices and security. Recommended prerequisites: Familiarity with computer systems concepts that could be satisfied by CS 205. Familiarity with programming in C, C++ or Java. Familiarity with basic concepts in probability and linear algebra that could be satisfied by Mth 301 or equivalent.

Also offered for undergraduate-level credit as CS 497 and may be taken only once for credit. .

CS 598 - Introduction to Wireless Network Protocols (3)

Classification of wireless networking systems; study of multiple access protocols in single hop and multi-hop networks; performance analysis of protocols; overview of emerging radio technologies for high-throughput next generation systems; study of wireless communication protocol standards for cellular systems; case studies of deployed systems.

Also offered for undergraduate-level credit as CS 498 and may be taken only once for credit. . Prerequisite: CS 250 or ECE 271.

CS 601 - Research (1-12)

(Credit to be arranged.) Consent of instructor.

CS 602 - Independent Study (1-12)

(Credit to be arranged.)

CS 603 - Dissertation (1-12)

(Credit to be arranged.) Consent of instructor.

CS 604 - Cooperative Education/Internship (1-8)

(Credit to be arranged.) Consent of instructor.

CS 605 - Reading and Conference (1-8)

(Credit to be arranged.) Consent of instructor.

CS 606 - Special Projects (1-12)

(Credit to be arranged.) Consent of instructor.

CS 607 - Seminar (1-4)

(Credit to be arranged.)

CS 610 - Selected Topics (1-8)

(Credit to be arranged.) Consent of instructor.

CS 653 - Design Patterns (3)

Software design patterns are reusable solutions to recurring software problems. They capture successful experiences and convey expert insight and knowledge to less experienced developers. Course provides an in-depth view of patterns using Java as the presentation language. Course is suitable to software architects and developers who are already well-versed in this language. In addition, it offers continuous opportunities for learning the most advanced features of the Java language and understanding some principles behind the design of its fundamental libraries.

Also offered as CS 553 and may be taken only once for credit. . Prerequisite: programming in Java and CS 520.

CS 655 - Software Specification and Verification (3)

Theoretical and practical aspects of the software development process or software lifecycle. Covers the first part of the cycle: formulating the external requirements, specifying what the software is to do, and the abstract design. Emphasis will be on the formal aspects of specification and verification.

Also offered as CS 555 and may be taken only once for credit.

CS 656 - Software Implementation and Testing (3)

Theoretical and practical aspects of the software development process or software lifecycle. Covers the second part of the cycle: detailed design, implementation in a programming language, testing, and maintenance. Emphasis will be on the technical aspects of software testing.

Also offered as CS 556 and may be taken only once for credit.

CS 658 - Programming Languages (3)

In-depth study of current and historical issues in the design, implementation, and application of programming languages. Topics range from basic to advanced. Areas include syntax, semantics, scoping, typing, abstraction, exceptions, and concurrency. Computational paradigms such as functional, logic, and/or object oriented are analyzed. Several "recent" programming languages used.

Also offered as CS 558 and may be taken only once for credit. .

CS 659 - Software Measurement and Models (3)

Survey, evaluation, and application of software measurement techniques and models. Particular emphasis on product metrics such as Software Science, Cyclomatic Complexity, and Function Points.

CS 668 - Functional Logic Programming (3)

Introduction to functional logic programming. Foundations and basic principles of this paradigm will be explained in some depth and complemented by encoding practical problems in a functional logic language using a leading compiler/ interpreter. Focus on non-determinism and computations with incomplete information. Implementation techniques will be briefly discussed.

Also offered as CS 568 and may be taken only once for credit. . Prerequisite: CS 558 Programming Languages.

CS 669 - Scholarship Skills for Computer Science and Engineering (3)

The purpose of this course is to make participants better scholars in Computer Science. In particular it attempts to help students become better researchers, better writers, better presenters, and better reviewers. It concentrates on reading, writing and composition skills: on the production and consumption of the "media" used by computer

scientists to communicate professionally. At the completion of the course, students should be familiar with the tasks and activities of modern scholars in computer science.

Also offered as CS 569 and may be taken only once for credit. . Prerequisite: admission into a Ph.D. program within MCECS.

CS 672 - Operating System Internals (3)

Internals of a specific operating system including structure of the kernel, block buffering cache, file system structure and system calls, process structure and scheduling, memory management, device driver interface, and inter process communication.

Also offered as CS 572 and may be taken only once for credit. .

CS 676 - Computer Security Research Seminar (3)

Seminar on emerging topics in computer security.

Also offered as CS 576 and may be taken only once for credit. .

CS 677 - Modern Language Processors (3)

An advanced course on compiler construction for modern programming languages, such as object-oriented or functional languages. Topics include type-checking, executable intermediate representations, interpretation and virtual machines, code generation for modern architectures, memory management and garbage collection, and optimization.

Also offered as CS 577 and may be taken only once for credit. . Prerequisite: CS 421.

CS 678 - Programming Language Semantics (3)

Introduction to the formal mathematical study of program meaning (semantics), using one or more approaches such as operational semantics, denotational semantics, or programming logics. Emphasis on rigorous mathematical development and formal proof techniques. Language features to be studied may include types and type safety, purity and imperative effects, functional and modular abstraction, polymorphism, higher-order functions, and object-oriented features. Expected preparation: CS 558 and/or CS 557.

Also offered as CS 578 and may be taken only once for credit. .

CS 684 - Algorithm Design and Analysis (3)

An advanced in-depth study in the design and analysis of algorithms. Topics include models of computation, sorting, data structures, graph algorithms, matrix multiplication, fast Fourier transform, polynomial arithmetic, pattern matching, and NP-complete problems.

Also offered as CS 584 and may be taken only once for credit. .

CS 696 - Network Management and Security (3)

Covers both network management and network security. Network management will include the design of LAN-based networks, including spanning tree protocols, bridge learning protocols, virtual LANs, and Ethernet switches, and the security of switches and routers. Network management protocols will be covered in-depth including switch and router management information bases, as well as associated SNMP protocols, and network monitoring tools. The second half of the class will focus on network security. In order to understand the network security problem, the security section will begin with a review of various forms of network attacks. We then turn to network-side security management including both passive measures like firewall defense schemes including packet filers, and bastion hosts. Newer secure protocols will then be covered including network-layer security and various application-layer secure protocols.

Prerequisite: CS 594.

CS 699 - Special Studies (1-6)

Credit to be arranged.

D - Dance

D 104 - Dance Appreciation (4)

Develop an awareness and appreciation of dance in its artistic, social and cultural contexts through a variety of experiences, viewing and participating in dance. Will cover the basic roles in dance along with concepts and principals such as space, time and effort as well as expression, form, style and period.

D 193 - Dance Laboratory: Modern I, II, III (2)

Beginning modern dance technique, emphasis on body alignment, strength, flexibility and development of basic technical skills. Maximum: 12 credits.

D 195 - Dance Laboratory: Topics I, II, III (2)

Beginning dance technique in topics to be named, for example musical theatre, tap, hip hop, etc. Maximum: 12 credits.

D 196 - Dance Laboratory: Ballet I, II, III (2)

Beginning ballet technique, emphasis on body alignment, development of basic technical skills, and understanding basic ballet vocabulary. Maximum: 12 credits.

D 197 - Dance Laboratory: Jazz I, II, III (2)

Beginning laboratory in jazz dance technique emphasizing body alignment, contraction, and isolation technique of Latin, West Indian, African and American rhythms. Maximum: 12 credits.

D 304 - Dance Appreciation (4)

Develop an awareness and appreciation of dance in its artistic, social and cultural contexts through a variety of experiences, viewing and participating in dance. Covers the basic roles involved in dance along with concepts and principals of dance such as space, time and effort as well as expression, form, style and period.

Prerequisite: Upper-division standing.

D 350 - Dance Improvisation (4)

An exploration of spontaneous movement as individual and group creativity and expression, as a potential performance form and as the beginnings of choreography. "The body thinks." Designed to develop awareness, focus, sensitivity and personal movement vocabularies. Expected preparation: upper division standing.

D 351 - Dance Composition (4)

Exploration of basic elements of dance and choreographic strategies through readings, observations and preparation of solo dance studies. Expected preparation: upper division standing.

D 352 - Dance Choreography (4)

Exploring compositional devices and craft unique to group choreography. Choreographing and producing a dance in a performance setting. Expected preparation: D 350, D 351.