

# Undergraduate studies

## Software Engineering (Bachelor of Software Engineering – Honours)

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### Systems of Study

Co-operative

### Minimum Average(s) Required

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- A minimum cumulative overall average of 60.0%.
- A minimum term average of 60.0%. See Faculty of Engineering [promotion rules](#).

### Graduation Requirements

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- Complete a total of 21.50 units (excluding COOP, PD):
  - Complete all the required courses listed below.
  - Complete 12 approved electives:
    - Complete two Complementary Studies Electives (CSEs) from the [Complementary Studies Course Lists for Engineering](#):
      - One course from List A.
      - One course from List C.
    - Complete three courses from the Natural Science list.
    - Complete four courses from the Technical Electives (TEs) lists.
    - Complete the Undergraduate Communication Requirement.
    - Complete two electives chosen from any 0.5-unit courses.
- Complete all co-operative education program requirements listed below.

### Undergraduate Communication Requirement

See below for the list of courses that can be used towards this requirement. The course must be completed with a minimum grade of 60.0% prior to enrolling in the 3A term.

### Co-operative Education Program Requirements

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- Complete a total of five PD courses: PD10, PD11, PD19, PD20, and one additional PD course.
- Complete a total of five credited work terms.

### Legend for Study/Work Sequences Chart

<b>Key</b>	<b>Description</b>
F,W,S	Terms: F=September-December; W=January-April; S=May-August
1,2,3,4 plus A or B	Denotes academic year and term.
WT	Work term.

## Study/Work Sequences Chart

<i>Sequence</i>	<i>F</i>	<i>W</i>	<i>S</i>	<i>F</i>	<i>W</i>	<i>S</i>	<i>F</i>	<i>W</i>	<i>S</i>	<i>F</i>	<i>W</i>	<i>S</i>	<i>F</i>	<i>W</i>
Stream 8X	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	WT	4A	4B
Stream 8Y	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	4A	WT	WT	4B

## Additional Constraints and Notes

- Stream 8X is the primary stream. Students may choose to switch to stream 8Y after the 3B term, with advisor approval.

## Course Requirements

### 1A Term



- Complete all the following:
  - [CS137](#) - Programming Principles (0.50)
  - [CHE102](#) - Chemistry for Engineers (0.50)
  - [MATH115](#) - Linear Algebra for Engineering (0.50)
  - [MATH117](#) - Calculus 1 for Engineering (0.50)
  - [MATH135](#) - Algebra for Honours Mathematics (0.50)
  - [SE101](#) - Introduction to Methods of Software Engineering (0.25)

### 1B Term



- Complete all of the following
  - Complete all the following:
    - [CS138](#) - Introduction to Data Abstraction and Implementation (0.50)
    - [ECE124](#) - Digital Circuits and Systems (0.50)
    - [ECE140](#) - Linear Circuits (0.50)
    - [ECE192](#) - Engineering Economics and Impact on Society (0.25)
    - [MATH119](#) - Calculus 2 for Engineering (0.50)
    - [SE102](#) - Seminar (0.00)
  - Complete 1 approved elective

### 2A Term



- Complete all of the following
  - Complete all the following:
    - [CS241](#) - Foundations of Sequential Programs (0.50)
    - [ECE222](#) - Digital Computers (0.50)
    - [SE201](#) - Seminar (0.00)
    - [SE212](#) - Logic and Computation (0.50)
    - [STAT206](#) - Statistics for Software Engineering (0.50)
  - Complete 1 of the following:
    - [ECE105](#) - Classical Mechanics (0.50)
    - [PHYS115](#) - Mechanics (0.50)
    - [PHYS121](#) - Mechanics (0.50)

**2B Term**

- Complete all of the following
  - Complete all the following:
    - CS240 - Data Structures and Data Management (0.50)
    - CS247 - Software Engineering Principles (0.50)
    - CS348 - Introduction to Database Management (0.50)
    - MATH239 - Introduction to Combinatorics (0.50)
    - SE202 - Seminar (0.00)
  - Complete 1 approved elective

**3A Term**

- Complete all of the following
  - Complete all the following:
    - CS341 - Algorithms (0.50)
    - MATH213 - Signals, Systems, and Differential Equations (0.50)
    - SE301 - Seminar (0.00)
    - SE350 - Operating Systems (0.50)
    - SE464 - Software Design and Architectures (0.50)
    - SE465 - Software Testing and Quality Assurance (0.50)
  - Complete 1 approved elective

**3B Term**

- Complete all of the following
  - Complete all the following:
    - CS343 - Concurrent and Parallel Programming (0.50)
    - ECE358 - Computer Networks (0.50)
    - SE302 - Seminar (0.00)
    - SE380 - Introduction to Feedback Control (0.50)
    - SE463 - Software Project Management, Requirements, and Analysis (0.50)
  - Complete 1 of the following:
    - CS349 - User Interfaces (0.50)
    - CS449 - Human-Computer Interaction (0.50)
    - MSE343 - Human-Computer Interaction (0.50)
  - Complete 1 approved elective

**4A Term**

- Complete all of the following
  - Complete all the following:
    - SE401 - Seminar (0.00)
  - Complete 1 of the following:
    - GENE403 - Interdisciplinary Design Project 1 (0.50)
    - SE490 - Design Project 1 (0.50)
  - Complete 4 approved electives

**4B Term**

- Complete all of the following
  - Complete all the following:
    - SE402 - Seminar (0.00)
  - Complete 1 of the following:
    - GENE404 - Interdisciplinary Design Project 2 (0.50)
    - SE491 - Design Project 2 (0.50)
  - Complete 4 approved electives

**Course Lists****Undergraduate Communication Requirement**

- Complete 1 of the following:
  - COMMST100 - Interpersonal Communication (0.50)
  - COMMST223 - Public Speaking (0.50)
  - EMLS101R - Oral Communications for Academic Purposes (0.50)
  - EMLS102R - Clear Communication in English Writing (0.50)
  - EMLS129R - Written Academic English (0.50)
  - ENGL109 - Introduction to Academic Writing (0.50)
  - ENGL119 - Communications in Mathematics and Computer Science (0.50)
  - ENGL129R - Written Academic English (0.50)
  - ENGL209 - Advanced Academic Writing (0.50)
  - ENGL210E - Genres of Technical Communication (0.50)

**Natural Science List**

- Complete all of the following
  - Complete a total of 3 lecture courses (see Additional Constraints).

- Choose any of the following:
  - [AMATH382](#) - Computational Modelling of Cellular Systems (0.50)
  - [BIOL110](#) - Biodiversity, Biomes, and Evolution (0.50)
  - [BIOL130](#) - Introductory Cell Biology (0.50)
  - [BIOL130L](#) - Cell Biology Laboratory (0.25)
  - [BIOL150](#) - Organismal and Evolutionary Ecology (0.50)
  - [BIOL165](#) - Diversity of Life (0.50)
  - [BIOL211](#) - Introductory Vertebrate Zoology (0.50)
  - [BIOL220](#) - Introduction to Plant Structure and Function (0.50)
  - [BIOL239](#) - Genetics (0.50)
  - [BIOL240](#) - Fundamentals of Microbiology (0.50)
  - [BIOL240L](#) - Microbiology Laboratory (0.25)
  - [BIOL241](#) - Introduction to Applied Microbiology (0.50)
  - [BIOL273](#) - Principles of Human Physiology 1 (0.50)
  - [BIOL280](#) - Introduction to Biophysics (0.50)
  - [BIOL365](#) - Methods in Bioinformatics (0.50)
  - [BIOL373](#) - Principles of Human Physiology 2 (0.50)
  - [BIOL373L](#) - Human Physiology Laboratory (0.25)
  - [BIOL376](#) - Cellular Neurophysiology (0.50)
  - [BIOL382](#) - Computational Modelling of Cellular Systems (0.50)
  - [BIOL469](#) - Genomics (0.50)
  - [BIOL476](#) - Systems Neuroscience: From Neurons to Behaviour (0.50)
  - [BIOL489](#) - Arctic Ecology (0.50)
  - [CHE161](#) - Engineering Biology (0.50)
  - [CHEM123](#) - General Chemistry 2 (0.50)
  - [CHEM123L](#) - General Chemistry Laboratory 2 (0.25)
  - [CHEM209](#) - Introductory Spectroscopy and Structure (0.50)
  - [CHEM237](#) - Introductory Biochemistry (0.50)
  - [CHEM237L](#) - Introductory Biochemistry Laboratory (0.25)
  - [CHEM254](#) - Introductory Chemical Thermodynamics (0.50)
  - [CHEM262](#) - Organic Chemistry for Engineering (0.50)
  - [CHEM262L](#) - Organic Chemistry Laboratory for Engineering Students (0.25)
  - [CHEM266](#) - Basic Organic Chemistry 1 (0.50)
  - [CHEM356](#) - Introductory Quantum Mechanics (0.50)
  - [CS482](#) - Computational Techniques in Biological Sequence Analysis (0.50)
  - [EARTH121](#) - Introductory Earth Sciences (0.50)
  - [EARTH122](#) - Introductory Environmental Sciences (0.50)
  - [EARTH123](#) - Introductory Hydrology (0.50)
  - [EARTH221](#) - Introductory Geochemistry (0.50)
  - [EARTH270](#) - Disasters and Natural Hazards (0.50)
  - [EARTH281](#) - Geological Impacts on Human Health (0.50)
  - [ECE106](#) - Electricity and Magnetism (0.50)
  - [ECE231](#) - Semiconductor Physics and Devices (0.50)
  - [ECE305](#) - Introduction to Quantum Mechanics (0.50)
  - [ECE403](#) - Thermal Physics (0.50)
  - [ECE404](#) - Geometrical and Physical Optics (0.50)
  - [ENVE275](#) - Aquatic Chemistry (0.50)

- [ENVS200](#) - Field Ecology (0.50)
- [NE222](#) - Organic Chemistry for Nanotechnology Engineers (0.50)
- [PHYS122](#) - Waves, Electricity and Magnetism (0.50)
- [PHYS124](#) - Modern Physics (0.50)
- [PHYS175](#) - Introduction to the Universe (0.50)
- [PHYS233](#) - Introduction to Quantum Mechanics (0.50)
- [PHYS234](#) - Quantum Physics 1 (0.50)
- [PHYS263](#) - Classical Mechanics and Special Relativity (0.50)
- [PHYS275](#) - Planets (0.50)
- [PHYS280](#) - Introduction to Biophysics (0.50)
- [PHYS334](#) - Quantum Physics 2 (0.50)
- [PHYS335](#) - Condensed Matter Physics (0.50)
- [PHYS375](#) - Stars (0.50)
- [PHYS380](#) - Molecular and Cellular Biophysics (0.50)
- [PHYS468](#) - Introduction to the Implementation of Quantum Information Processing (0.50)
- [PSYCH207](#) - Cognitive Processes (0.50)
- [PSYCH261](#) - Physiological Psychology (0.50)
- [PSYCH306](#) - Perception (0.50)
- [PSYCH307](#) - Human Neuropsychology (0.50)
- [SCI200](#) - Energy - Its Development, Use, and Issues (0.50)
- [SCI201](#) - Global Warming and Climate Change (0.50)
- [SCI238](#) - Introductory Astronomy (0.50)
- [SCI250](#) - Environmental Geology (0.50)

#### Technical Electives List



- Complete a minimum of 4 Technical Electives.

#### List 1



- Complete 1 of the following:
  - [AMATH242](#) - Introduction to Computational Mathematics (0.50)
  - [AMATH449](#) - Neural Networks (0.50)
  - [CS360](#) - Introduction to the Theory of Computing (0.50)
  - [CS365](#) - Models of Computation (0.50)
  - [CS370](#) - Numerical Computation (0.50)
  - [CS371](#) - Introduction to Computational Mathematics (0.50)
  - [CS442](#) - Principles of Programming Languages (0.50)
  - [CS444](#) - Compiler Construction (0.50)
  - [CS448](#) - Database Systems Implementation (0.50)
  - [CS450](#) - Computer Architecture (0.50)
  - [CS451](#) - Data-Intensive Distributed Computing (0.50)
  - [CS452](#) - Real-Time Programming (0.50)
  - [CS453](#) - Software and Systems Security (0.50)
  - [CS454](#) - Distributed Systems (0.50)
  - [CS457](#) - System Performance Evaluation (0.50)
  - [CS459](#) - Privacy, Cryptography, Network and Data Security (0.50)
  - [CS462](#) - Formal Languages and Parsing (0.50)
  - [CS466](#) - Algorithm Design and Analysis (0.50)
  - [CS479](#) - Neural Networks (0.50)
  - [CS480](#) - Introduction to Machine Learning (0.50)
  - [CS484](#) - Computational Vision (0.50)
  - [CS485](#) - Statistical and Computational Foundations of Machine Learning (0.50)
  - [CS486](#) - Introduction to Artificial Intelligence (0.50)
  - [CS487](#) - Introduction to Symbolic Computation (0.50)
  - [CS488](#) - Introduction to Computer Graphics (0.50)
  - [CS489](#) - Advanced Topics in Computer Science (0.50)

**List 2**



- Complete 1 of the following:
  - [ECE313](#) - Digital Signal Processing (0.50)
  - [ECE320](#) - Computer Architecture (0.50)
  - [ECE327](#) - Digital Hardware Systems (0.50)
  - [ECE340](#) - Electronic Circuits 2 (0.50)
  - [ECE405A](#) - Quantum Information Processing Devices (0.50)
  - [ECE405B](#) - Fundamentals of Experimental Quantum Information (0.50)
  - [ECE405C](#) - Programming of Quantum Computing Algorithms (0.50)
  - [ECE405D](#) - Superconducting Quantum Circuits (0.50)
  - [ECE409](#) - Cryptography and System Security (0.50)
  - [ECE416](#) - Advanced Topics in Networking (0.50)
  - [ECE417](#) - Image Processing (0.50)
  - [ECE423](#) - Embedded Computer Systems (0.50)
  - [ECE454](#) - Distributed Computing (0.50)
  - [ECE455](#) - Embedded Software (0.50)
  - [ECE457A](#) - Co-operative and Adaptive Algorithms (0.50)
  - [ECE457B](#) - Fundamentals of Computational Intelligence (0.50)
  - [ECE457C](#) - Reinforcement Learning (0.50)
  - [ECE458](#) - Computer Security (0.50)
  - [ECE459](#) - Programming for Performance (0.50)
  - [ECE481](#) - Digital Control Systems (0.50)
  - [ECE486](#) - Robot Dynamics and Control (0.50)
  - [ECE488](#) - Multivariable Control Systems (0.50)
  - [ECE493](#) - Special Topics in Electrical and Computer Engineering (0.50)
  - [ECE495](#) - Autonomous Vehicles (0.50)

**List 3**

- Complete all of the following
  - Complete 2 additional course from List 1, List 2, or List 3.
  - Choose any of the following:
    - BIOL487 - Computational Neuroscience (0.50)
    - CO331 - Coding Theory (0.50)
    - CO342 - Introduction to Graph Theory (0.50)
    - CO351 - Network Flow Theory (0.50)
    - CO353 - Computational Discrete Optimization (0.50)
    - CO367 - Nonlinear Optimization (0.50)
    - CO456 - Introduction to Game Theory (0.50)
    - CO481 - Introduction to Quantum Information Processing (0.50)
    - CO485 - The Mathematics of Public-Key Cryptography (0.50)
    - CO487 - Applied Cryptography (0.50)
    - CS467 - Introduction to Quantum Information Processing (0.50)
    - MSE343 - Human-Computer Interaction (0.50)
    - MSE446 - Introduction to Machine Learning (0.50)
    - MSE543 - Analytics and User Experience (0.50)
    - MTE544 - Autonomous Mobile Robots (0.50)
    - MTE546 - Multi-Sensor Data Fusion (0.50)
    - PHYS467 - Introduction to Quantum Information Processing (0.50)
    - SE498 - Advanced Topics in Software Engineering (0.50)
    - STAT440 - Computational Inference (0.50)
    - STAT441 - Statistical Learning - Classification (0.50)
    - STAT442 - Data Visualization (0.50)
    - STAT444 - Statistical Learning - Advanced Regression (0.50)
    - SYDE533 - Conflict Resolution (0.50)
    - SYDE543 - Cognitive Ergonomics (0.50)
    - SYDE548 - User Centred Design Methods (0.50)
    - SYDE552 - Computational Neuroscience (0.50)
    - SYDE556 - Simulating Neurobiological Systems (0.50)
    - SYDE575 - Image Processing (0.50)

## Additional Requirements



- Complete all of the following
  - Complete 1 sustainability-related course, from the following list. This course may also be counted towards another elective requirement (e.g., Natural Science elective, Complementary Studies elective) if part of that list.
  - Complete 1 of the following:
    - BIOL489 - Arctic Ecology (0.50)
    - EARTH270 - Disasters and Natural Hazards (0.50)
    - ENBUS102 - Introduction to Environment and Business (0.50)
    - ENBUS211 - Principles of Marketing for Sustainability Professionals (0.50)
    - ENGL248 - Literature for an Ailing Planet (0.50)
    - ENVS105 - Environmental Sustainability and Ethics (0.50)
    - ENVS200 - Field Ecology (0.50)
    - ENVS205 - Sustainability: The Future We Want (0.50)
    - ENVS220 - Ecological Economics (0.50)
    - ERS215 - Environmental and Sustainability Assessment 1 (0.50)
    - ERS225 - Gendering Environmental Politics (0.50)
    - ERS253 - Communities and Sustainability (0.50)
    - ERS270 - Introduction to Sustainable Agroecosystems (0.50)
    - ERS294 - Spirituality, Religion, and Ecology (0.50)
    - ERS310 - Peace and the Environment (0.50)
    - ERS316 - Urban Water and Wastewater Systems: Integrated Planning and Management (0.50)
    - ERS320 - Economics and Sustainability (0.50)
    - ERS328 - Environmental Politics and System Change (0.50)
    - ERS361 - Food Systems and Sustainability (0.50)
    - ERS370 - Corporate Sustainability: Issues and Prospects (0.50)
    - ERS372 - First Nations and the Environment (0.50)
    - ERS404 - Global Environmental Governance (0.50)
    - GEOG203 - Environment and Development in a Global Perspective (0.50)
    - GEOG207 - Climate Change Fundamentals (0.50)
    - GEOG225 - Global Environment and Health (0.50)
    - GEOG361 - Food Systems and Sustainability (0.50)
    - GEOG459 - Energy and Sustainability (1.00)
    - PACS310 - Peace and the Environment (0.50)
    - PHIL224 - Environmental Ethics (0.50)
    - PLAN451 - Environmental Planning in Rural and Regional Systems (0.50)
    - PSCI432 - Global Environmental Governance (0.50)
    - RCS285 - Spirituality, Religion, and Ecology (0.50)
    - SCI200 - Energy - Its Development, Use, and Issues (0.50)
    - SCI201 - Global Warming and Climate Change (0.50)
    - THPERF374 - Sustainability in Design (0.50)

### Additional Constraints

1. For the Natural Science requirement, if a 0.25-laboratory course accompanies a lecture course, the laboratory course must also be taken and the pair together count as one course towards the three-course requirement (e.g., BIOL130 with BIOL130L).
2. To accommodate an elective reduced load, CHE102, CS343, CS348, CS349, CS449, ECE140, ECE192, ECE358, MSE343, and SE380 may be taken out of sequence.
3. Courses in the Technical Electives Lists may not be taken before the 3A term.

4. Students will only be permitted to use the WD and WF provisions used in the Faculty of Mathematics to withdraw from extra courses taken above the degree requirements.
5. Exceptions to the requirements and electives listed above require prior approval of the Software Engineering Director.

## Specializations

Students may choose to focus their elective choices by completing one (or more) of four available specializations.

## Specializations List

- [SE-Artificial Intelligence Specialization](#), [SE-Business Specialization](#), [SE-Computational Fine Art Specialization](#), or [SE-Human-Computer Interaction Specialization](#)

## Notes

- Software Engineering students are considered as both Engineering and Mathematics students:
  - Students can take advantage of degree enhancements available to students from either faculty. These enhancements take the form of additional plans such as options, specializations, minors, and joint honours. Before declaring any academic plan, see [invalid credential combinations](#).
  - Students are eligible for Awards of Excellence in the Faculty of Engineering as well as for Awards of Excellence in the Faculty of Mathematics.
  - The Software Engineering plan is also considered an Honours Mathematics plan for purposes of student access to Mathematics courses.

## Offered by Faculty(ies)

Faculties of Engineering and Mathematics



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The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg, and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is co-ordinated within the [Office of Indigenous Relations <https://uwaterloo.ca/indigenous>](https://uwaterloo.ca/indigenous).



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