

# COMPUTER ENGINEERING

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Computer Engineers deal with the architecture, design, implementation, and verification of the hardware and software for computing systems that are increasingly being used in embedded or networked environments. The Computer Engineering plan offers a broad range of supporting course material to prepare graduates for entry into the profession. In the hardware area, courses cover digital logic and digital systems engineering, computer organization and system architecture, microprocessors, and integrated circuit engineering. Software courses include programming languages, data structures and algorithms, operating systems, real-time software design, databases, compilers, software requirements analysis, formal methods in software engineering, and techniques for human-computer interaction. Computer communication network courses include material on reliable and secure information transfer protocols, switching and routing through multipath networks, and wireless networking.

The Computer Engineering plan is "streamed". Through choice of elective courses in third and fourth year, students can either focus their studies in one or more areas of specialization ("streams"), or pursue a broader coverage of the subject field. Streams are detailed on the Departmental web pages.

*First Year courses in Computer Science (APSC 142 Introduction to Computer Programming for Engineers 2), Mathematics (APSC 171 Calculus I, APSC 172 Calculus II and APSC 174 Introduction To Linear Algebra), Engineering Practice (APSC 100 Engineering Practice 1) and Physics (APSC 112 Physics II) form the basis for further study in Computer Engineering. Good performance is advisable for students planning to enter this academic plan.*

## Programs

- Computer Engineering, B.A.Sc. (Class of 2024) (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-basc-class-2023/>)
- Computer Engineering, B.A.Sc. (Class of 2025) (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-basc-class-2024/>)

sciences/academic-plans/computer-engineering/computer-engineering-basc-class-2024/)

- Computer Engineering, B.A.Sc. (Class of 2026) (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-basc-class-2026/>)
- Computer Engineering, ECEi Stream, B.A.Sc. (Class of 2024) (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-ecei-stream-basc-class-2023/>)
- Computer Engineering, ECEi Stream, B.A.Sc. (Class of 2025) (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-ecei-stream-basc-class-2024/>)
- Computer Engineering, ECEi Stream, B.A.Sc. (Class of 2026) (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-ecei-stream-basc-class-2026/>)
- Computer Engineering: Electives (<https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/computer-engineering/computer-engineering-electives/>)

### CMPE 204 Logic For Computing Science Units: 3.00

Elements of mathematical logic with computing applications. Formal proof systems for propositional and predicate logic. Interpretations, validity, and satisfiability. Introduction to soundness, completeness and decidability.  
K3(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 270 or CISC 203

Corequisites: Exclusions:

**Offering Term:** FW

**CEAB Units:**

Mathematics 36

Natural Sciences 0

Complementary Studies 0

Engineering Science 0

Engineering Design 0

**Offering Faculty:** Faculty of Arts and Science



**CMPE 212 Introduction to Computing Science II Units: 4.00**

Introduction to object-oriented design, architecture, and programming. Use of packages, class libraries, and interfaces. Encapsulation and representational abstraction. Inheritance. Polymorphic programming. Exception handling. Iterators. Introduction to a class design notation. Applications in various areas.

(Lec: 3, Lab: 1, Tut: 0)

**Requirements:** Prerequisites: APSC 142 or APSC 143 or MNTC 313, ELEC 278 Corequisites: Exclusions: CISC 124

**Offering Term:** FW

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 26

Engineering Design 22

**Offering Faculty:** Faculty of Arts and Science

**CMPE 223 Software Specifications Units: 3.00**

Introduction to techniques for specifying the behaviour of software, with applications of these techniques to design, verification and construction of software. Logic-based techniques such as loop invariants and class invariants. Automata and grammar-based techniques, with applications to scanners, parsers, user-interface dialogs and embedded systems. Computability issues in software specifications.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 278, ELEC 270

Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science

**CMPE 251 Data Analytics Units: 3.00**

Introduction to data analytics; data preparation; assessing performance; prediction methods such as decision trees, random forests, support vector machines, neural networks and rules; ensemble methods such as bagging and boosting; clustering techniques such as expectation-maximization, matrix decompositions, and biclustering; attribute selection. K3(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: APSC 142 or APSC 143 or MNTC 313, or programming experience recommended

Corequisites: Exclusions: CISC 251, CMPE 333, CISC 333

**Offering Term:** F

**CEAB Units:**

Mathematics 10

Natural Sciences 0

Complementary Studies 0

Engineering Science 14

Engineering Design 12

**Offering Faculty:** Smith Engineering

**CMPE 271 Scientific Computing Units: 3.00**

Introduction to scientific computing: floating point arithmetic, algorithm design, error analysis, ill-conditioning. Zero-finding. Linear equations. Interpolation. Integration. Least-squares fitting. Effective use of library programs, with discussion of their limitations and some aspects of their design and implementation.

COURSE DELETED 2019-2020

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** PREREQ: APSC 143 and APSC 172 and APSC 174 and registered in BSCE or BASC. EXCLUSION: ENPH 213

**Offering Term:** W

**CEAB Units:**

Mathematics 21

Natural Sciences 0

Complementary Studies 0

Engineering Science 15

Engineering Design 0

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 320 Fndmnts Software Development Units: 4.00**

Introduction to management of small and medium-scale software projects. Advanced programming methodology using the programming language C++. Includes a significant programming project.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: ELEC 278 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 26

Engineering Design 22

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 322 Software Architecture Units: 4.00**

Abstractions and patterns of interactions and relationships among modules. Design recovery; relationship of architecture to requirements and testing.

K4(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: ELEC 270, CMPE 223 (CISC 223),

ELEC 278 Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 22

Engineering Design 26

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 323 Intro To Software Engineering Units: 3.50**

This course provides an applied introduction to the principles and practice of the engineering of software artifacts. Topics include: processes for managing software development, software architecture, software design, software quality management, software testing and human-factors of computing systems. The course is illustrated with case studies in industrial practice in software engineering.

(0/0/0/34/8)~ COURSE DELETED IN 2009/10 ~

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 34

Engineering Design 8

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 324 Operating Systems Units: 3.00**

Layered operating systems for conventional shared memory computers: Concurrent processes, Synchronization and communication, Concurrent algorithms, Scheduling Deadlock, Memory management, Protection. File systems. Device management. Typical layers.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 274, ELEC 278

Corequisites: Exclusions: ELEC 377

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 36

Engineering Design 0

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 325 Human-Computer Interaction Units: 3.00**

Developing usable software requires that human factors be considered throughout the design and development process. This course introduces a series of techniques for development and evaluating usable software, and shows how these techniques can be integrated into a process for software development. Alternately offered as CISC 325.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 278 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Smith Engineering

**CMPE 326 Game Architecture Units: 4.00**

An introduction to software architectural design through the application domain of game development. Topics will include notations for expressing static and dynamic aspects of software architecture, design patterns, interface design, and application of these techniques to 3D games, mobile games and web-based games.

COURSE DELETED 2017-2018

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: ELEC 270, ELEC 278, ELEC 377

Corequisites: Exclusions: CMPE 322

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 26

Engineering Design 22

**Offering Faculty:** Smith Engineering

**CMPE 327 Software Quality Assurance Units: 3.00**

Validation of software throughout the life cycle. Comparative effectiveness in defect removal of formal methods (proofs of correctness), inspection (walkthroughs and reviews), and testing (unit, integration, and system testing; white box versus black box).

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 279 or CMPE 212

Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Smith Engineering

**CMPE 330 Computer-Integrated Surgery Units: 3.00**

Concepts of computer-integrated surgery systems and underlying techniques such as medical-image computing, robotics, and virtual reality, learned through real-life applications and problems. Techniques learned in class will be applied in a hands-on surgery session where students perform minimally invasive surgery with virtual-reality navigation tools. Enrolment is limited.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 279 or CMPE 212,

MTHE 272 or ELEC 372 or ENPH 213 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 36

Engineering Design 0

**Offering Faculty:** Faculty of Arts and Science

**CMPE 332 Database Management Systems Units: 3.00**

Data models: relational, entity-relationship. Relational query languages: relational algebra and SQL. Relational database design. Application interfaces and embedded SQL. Storage and indexing.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 278, ELEC 270 or

MTHE 217 (MATH 217) Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 333 Data Analytics Units: 3.00**

Introduction to data analytics; data preparation; assessing performance; prediction methods such as decision trees, random forests, support vector machines, neural networks and rules; ensemble methods such as bagging and boosting; clustering techniques such as expectation-maximization, matrix decompositions, and biclustering; attribute selection. COURSE DELETED 2017-2018

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** PREREQ: APSC 142 or APSC 143, or programming experience recommended.

**Offering Term:** W

**CEAB Units:**

Mathematics 10

Natural Sciences 0

Complementary Studies 0

Engineering Science 14

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 351 Advanced Data Analytics Units: 3.00**

Design and implementation of complex analytics techniques; predictive algorithms at scale; deep learning; clustering at scale; advanced matrix decompositions, analytics in the Web, collaborative filtering; social network analysis; applications in specialized domains.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: CMPE 251, ELEC 326 or MTHE 351 Corequisites: Exclusions: CISC 351, CISC 372

**Offering Term:** W

**CEAB Units:**

Mathematics 10

Natural Sciences 0

Complementary Studies 0

Engineering Science 14

Engineering Design 12

**Offering Faculty:** Smith Engineering

### **CMPE 365 Algorithms I Units: 4.00**

Principles of design, analysis and implementation of efficient algorithms. Case studies from a variety of areas illustrate divide and conquer methods, the greedy approach, branch and bound algorithms and dynamic programming.

(Lec: 3, Lab: 1, Tut: 0)

**Requirements:** Prerequisites: ELEC 278, ELEC 270 or any discrete mathematics course Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 24

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 422 Formal Methods In Software Eng Units: 3.00**

Mathematical methods for describing software behaviour and structure. Topics include (but are not limited to) the following: requirements specification; Module specification: axiomatic, algebraic, and trace specification; program specification: abstract models; verification; specification-based validation.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: CMPE 204 (CISC 204), CMPE 223 (CISC 223) Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 14

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 10

**Offering Faculty:** Faculty of Arts and Science

### **CMPE 425 Advanced User Interface Design Units: 3.00**

Advanced user interface styles such as multimedia, support for collaboration over the Internet, virtual reality and wearable computers. Processes supporting the design of advanced user interfaces. Implementation techniques.

NOT OFFERED 2023-2024

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: CMPE 325 or permission of the instructor Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Smith Engineering

### **CMPE 432 Advanced Database Systems Units: 3.00**

Topics include the presentation and storage of data, implementation concerns, and the integration of databases with other areas of computer science.

NOT OFFERED 2023-2024

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: CMPE 332 (CISC 332), ELEC 278 Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science

**CMPE 434 Distributed Systems Units: 3.00**

Operating systems for distributed architectures: distributed system characteristics, process synchronization and communication. Basic distributed algorithms. Principles of fault tolerance. Reliable broadcast. Naming. File systems. Load balancing. Layering, Security.

NOT OFFERED 2022-2023

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 377 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science

**CMPE 452 Neural Networks and Genetic Algorithms Units: 3.00**

Artificial Neural Networks (ANN) and Genetic Algorithms (GA) for problem solving and prediction tasks such as classification, clustering, optimization and data reduction and modeling human cognition, with application to real world problems. Ongoing research in this area in various application domains.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 278, or permission of the instructor Corequisites: Exclusions: ELEC 425

**Offering Term:** F

**CEAB Units:**

Mathematics 9

Natural Sciences 15

Complementary Studies 0

Engineering Science 12

Engineering Design 0

**Offering Faculty:** Faculty of Arts and Science

**CMPE 454 Computer Graphics Units: 3.00**

An introduction to computer graphics, including a review of current hardware; modelling and transformations in two and three dimensions; visual realism; perspective, hidden surface elimination, and shading; colour models; applications in several fields.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: ELEC 278 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science

**CMPE 457 Image Processing & Computer Units: 3.00**

Fundamental concepts and applications in image processing and computer vision. Topics include image acquisition, convolution. Discrete Fourier Transform, image enhancement edge detection, segmentation, image registration, human contrast perception, colour perception and reproduction, and stereo vision.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: Any first-year algebra course, any first-year calculus course, ELEC 278 Corequisites:

Exclusions: ELEC 474

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Faculty of Arts and Science



**CMPE 458 Programming Language Processor Units: 4.00**

Introduction to the systematic construction of a compiler: grammars and languages, scanners, top-down and bottom-up parsing, runtime organization, symbol tables, internal representations; Polish notation, syntax trees, semantic routines, storage allocation, code generation, interpreters. (Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: ELEC 279 or CISC 121 or CMPE 212 and ELEC 274 Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 30

Engineering Design 18

**Offering Faculty:** Faculty of Arts and Science

**CMPE 471 Computational Biology Units: 3.00**

Introduction to computational approaches to the problems in molecular biology. This will include the study of areas such as techniques and algorithms for sequence analysis and alignment; molecular databases; protein structure prediction and molecular data mining.

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: CMPE 365 (CISC 365), OR ELEC 278, MBIO 218 Corequisites: BCHM 315 Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 18

Complementary Studies 0

Engineering Science 9

Engineering Design 9

**Offering Faculty:** Faculty of Arts and Science

**CMPE 472 Medical Informatics Units: 3.00**

Current topics in the application of information technology to medicine, including computed tomography and x-ray imaging; 2D and 3D ultrasound; computer-assisted planning of interventional procedures; image registration; computer-assisted surgery; bioelectric signals; picture archiving and communication systems (PACS).

(Lec: 3, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: CMPE 330 Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 18

Complementary Studies 0

Engineering Science 18

Engineering Design 0

**Offering Faculty:** Faculty of Arts and Science