MATHEMATICS AND ENGINEERING

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This plan was developed at Queen's in response to the need for engineers who possess the skills and insights of applied mathematicians. In the second and third years of the plan, half of the curriculum consists of honours courses in pure and applied mathematics; the balance consists of engineering courses in one of three sub-plans offered in cooperation with the departments of Mechanical, Electrical and Computer Engineering, and the School of Computing. The sub-plans are developed with appropriate applications of mathematics to engineering in the final year. The sub-plans are:

Options available:

- (M6) Applied Mechanics: (mechanics, dynamics, fluid mechanics, thermodynamics)
- (M9) Computing and Communications: (computer science, software design, communication, information systems, and electrical engineering)
- (M11) Systems and Robotics: (electrical and mechanical engineering, control, communications, information systems, robotics, and mechanics)

Programs

- Mathematics and Engineering, B.A.Sc. (Class of 2026) (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/mathematics-engineering/mathematics-engineering-basc-class-2026/)
- Mathematics and Engineering, B.A.Sc. (Class of 2027) (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/mathematics-engineering/mathematics-engineering-basc-class-2027/)

Courses

MTHE 212 Linear Algebra Units: 3.50
Vector spaces, direct sums, linear transformations, eigenvalues, eigenvectors, inner product spaces, self-adjoint operators, positive operators, singular-value decomposition, minimal polynomials, Jordan canonical form, the projection theorem, applications to approximation and optimization problems.
(Lec: 3, Lab: 0, Tut: 0.5)

Requirements: Prerequisites: APSC 174 Corequisites: Exclusions: MTHE 312 (MATH 312)

Offering Term: W

CEAB Units:
Mathematics 42
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0

Offering Faculty: Smith Engineering

Course Learning Outcomes:

1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 217  Algebraic Structures with Applications  Units: 3.50
Introduction to algebraic systems and structures, and their engineering applications. Topics include symbolic logic; switching and logic circuits; set theory, equivalence relations and mappings; the integers and modular arithmetic; groups, cyclic groups, Lagrange's theorem, group quotients, group homomorphisms and isomorphisms; applications to error-control codes for noisy communication channels.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 174
Exclusions:
Offering Term: F
CEAB Units:
Mathematics 18
Natural Sciences 0
Complementary Studies 0
Engineering Science 16
Engineering Design 8
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 224  Applied Math For Civil Eng.  Units: 4.20
The course will discuss the application of linear differential equations with constant coefficients, and systems of linear equations within the realm of civil engineering. Additionally, the course will explore relevant data analysis techniques including: graphical and statistical analysis and presentation of experimental data, random sampling, estimation using confidence intervals, linear regression, residuals and correlation.
(Lec: 3, Lab: 0.4, Tut: 0.8)
Requirements: Prerequisites: APSC 142 or APSC 143 or MNTC 313, APSC 172, APSC 174
Corequisites: Exclusions:
MTHE 225 (MATH 225), MATH 226, MTHE 235 (MATH 235), MTHE 237 (MATH 237), STAT 267, MTHE 367 (STAT 367)
Offering Term: F
CEAB Units:
Mathematics 50
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 225  Ordinary Differential Equations  Units: 3.50
First order differential equations, linear differential equations with constant coefficients, and applications, Laplace transforms, systems of linear equations.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 171, APSC 172, APSC 174
Corequisites: Exclusions:
Offering Term: FWS
CEAB Units:
Mathematics 42
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Course Equivalencies: MATH225;MTHE225
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 227  Vector Analysis  Units: 3.00
Review of multiple integrals. Differentiation and integration of vectors; line, surface and volume integrals; gradient, divergence and curl; conservative fields and potential. Spherical and cylindrical coordinates, solid angle. Green's and Stokes' theorems, the divergence theorem. (Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: APSC 171, APSC 172, APSC 174
Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 36
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science

MTHE 228  Complex Analysis  Units: 3.50
Complex arithmetic, complex plane. Differentiation, analytic functions. Elementary functions. Elementary functions. Contour integration, Cauchy's Theorem and Integral Formula. Taylor and Laurent series, residues with applications to evaluation of integrals. (Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 171, APSC 172, APSC 174
Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 42
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 235  Diff Equations For Elec & Comp  Units: 3.50
Topics include developing and analyzing mathematical models describing physical and natural phenomena and those arising in electrical engineering applications (such as circuits), classification of differential equations, methods for solving differential equations, Laplace Transform method, systems of differential equations and connections with Linear Algebra, stability of systems. (Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 171, APSC 172, APSC 174
Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 18
Natural Sciences 11
Complementary Studies 0
Engineering Science 13
Engineering Design 0
Offering Faculty: Faculty of Arts and Science

MTHE 237  Differential Equations for Engineering Science  Units: 3.50
Topics include developing and analyzing mathematical models describing physical and natural dynamical phenomena and those arising in various engineering system applications, classification of differential equations, methods for solving differential equations, Laplace Transform method, systems of differential equations and connections with Linear Algebra, stability of linear and nonlinear systems and Lyapunov's method. (Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 171, APSC 172, APSC 174
Corequisites: Exclusions: MATH 231, MTHE 232 (MATH 232)
Offering Term: F
CEAB Units:
Mathematics 16
Natural Sciences 11
Complementary Studies 0
Engineering Science 15
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 280  Advanced Calculus  Units: 3.50
Limits, Continuity, C', and linear approximations of functions of several variables. Multiple integrals and Jacobians, Line and surface integrals. The theorems of Green, Stokes, and Gauss.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 172, APSC 174
Corequisites: Exclusions: MATH 221, MTHE 227 (MATH 227)
Offering Term: F
CEAB Units:
Mathematics 42
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 281  Introduction To Real Analysis  Units: 3.50
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 172 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 42
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 326  Functions of a Complex Variable  Units: 3.50
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 280 (MATH 280), MTHE 281 (MATH 281) Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 42
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 328  Real Analysis  Units: 3.00
Topological notions on Euclidean spaces, continuity and differentiability of functions of several variables, uniform continuity, extreme value theorem, implicit function theorem, completeness and Banach spaces, Picard-Lindelöf theorem, applications to constrained optimization and Lagrange multipliers, and existence/uniqueness of solutions to systems of differential equations.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: MTHE 281 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 28
Natural Sciences 8
Complementary Studies 0
Engineering Science 0
Engineering Design 0
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. N/A
MTHE 332 Introduction To Control Units: 4.00
Modeling control systems, linearization around an equilibrium point. Block diagrams, impulse response, transfer function, frequency response. Controllability and observability, LTI realizations. Feedback and stability, Lyapunov stability criterion, pole placement, Routh criterion. Input/output stability, design of PID controllers, Bode plots, Nyquist plots, Nyquist stability criterion, robust controllers. Laboratory experiments illustrate the control concepts learned in class.
NOT OFFERED 2024-2025
(Lec: 3, Lab: 0.5, Tut: 0.5)
Requirements: Prerequisites: MTHE 326 (MATH 326)
Corequisites: MTHE 335 Exclusions:
Offering Term: W
CEAB Units:
Mathematics 15
Natural Sciences 5
Complementary Studies 0
Engineering Science 23
Engineering Design 5
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 334 Math Methods For Engrg & Phys Units: 3.50
Banach and Hilbert spaces of continuous- and discrete-time signals; spaces of continuous and not necessarily continuous signals; continuous-discrete Fourier transform; continuous-continuous Fourier transform; discrete-continuous Fourier transform; discrete-discrete Fourier transform; transform inversion using Fourier series and Fourier integrals.
NOT OFFERED 2024-2025
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 212 (MATH 212), MTHE 281 (MATH 281) Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 28
Natural Sciences 0
Complementary Studies 0
Engineering Science 14
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 335 Mathematics of Engineering Systems Units: 3.50
Review of signal spaces arising in systems theory and applications, such as linear spaces, Banach and Hilbert spaces, and distributions. Approximation and representation of signals. Discrete and continuous Fourier Transforms, Laplace and Z transforms. Linear input/output systems and their stability and regularity analysis. Frequency-domain and time-domain analysis of linear time-invariant systems. Applications to modulation of communication signals, linear filter design, system design, control design, and digital sampling.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 326 or MTHE 228 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 8
Natural Sciences 6
Complementary Studies 0
Engineering Science 14
Engineering Design 14
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 337 Intro. To Operations Research Units: 3.00
Topics include Markov chains, Introduction to dynamic programming and Markov Decision Processes, simulation, queuing theory, inventory theory, and introduction to reinforcement learning.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: MTHE 351 or permission of the instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 18
Natural Sciences 0
Complementary Studies 0
Engineering Science 9
Engineering Design 9
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 338  Fourier Methods for Boundary Value Problems  Units: 3.50
Methods and theory for ordinary and partial differential equations; separation of variables in rectangular and cylindrical coordinate systems; sinusoidal and Bessel orthogonal functions; the wave, diffusion, and Laplace's equation; Sturm-Liouville theory; Fourier transform techniques.
NOT OFFERED 2024-2025
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 227 (MATH 227) or MTHE 280 (MATH 280), MTHE 237 (MATH 237) or MTHE 225 (MATH 225), or permission of the instructor Corequisites: Exclusions: 
Offering Term: W
CEAB Units:
Mathematics 28
Natural Sciences 0
Complementary Studies 0
Engineering Science 14
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 339  Evolutionary Game Theory  Units: 3.00
This course highlights the usefulness of game theoretical approaches in solving problems in the natural sciences and economics. Basic ideas of game theory, including Nash equilibrium and mixed strategies; stability using approaches developed for the study of dynamical systems, including evolutionary stability and replicator dynamics; the emergence of co-operative behaviour; limitations of applying the theory to human behaviour.
NOT OFFERED 2024-2025.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: APSC 172 or MATH 120 (or MATH 121); APSC 174 or MATH 110 (or MATH 111) recommended Corequisites: Exclusions: MATH 239
Offering Term: W
CEAB Units:
Mathematics 18
Natural Sciences 9
Complementary Studies 9
Engineering Science 0
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 351 Probability I Units: 3.50
Introduction to probability theory and its applications in engineering science: basic concepts of probability, counting, conditional probability, Bayes' rule, independence; probability models; random variables, distribution functions, probability mass functions, probability density functions; expectation, variance, moments; jointly distributed random variables; transformations of random variables. Distributions: Bernoulli, binomial, geometric, negative binomial, Poisson, uniform, exponential, normal. Applications: elementary stochastic processes, noisy communication channels.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Corequisites: MTHE 280
Exclusions: STAT 251
Offering Term: F
CEAB Units:
Mathematics 20
Natural Sciences 0
Complementary Studies 0
Engineering Science 22
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 353 Probability II Units: 3.00
Intermediate probability theory as a basis for further study in mathematical statistics and stochastic processes and applications; probability measures, expectations; modes of convergence of sequences of random variables; conditional expectations; independent systems of random variables; Gaussian systems; characteristic functions; Law of large numbers, Central limit theory; some notions of dependence.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: STAT 251 or MTHE 351 (STAT 351), APSC 174, MTHE 281 (MATH 281) Corequisites:
Exclusions:
Offering Term: W
CEAB Units:
Mathematics 26
Natural Sciences 0
Complementary Studies 0
Engineering Science 10
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 367 Engineering Data Analysis  Units: 3.50
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 171, APSC 172
Corequisites: Exclusions: STAT 261, STAT 263, STAT 266, STAT 267
Offering Term: W
CEAB Units:
Mathematics 31
Natural Sciences 0
Complementary Studies 0
Engineering Science 11
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 393 Engineering Design and Practice for Mathematics and Engineering  Units: 4.00
This is a project-based design course where methods of applied mathematics are used to solve a complex open-ended engineering problem. The projects involve using system theoretic methods for modeling, analysis, and design applied to engineering problems arising in a variety of engineering disciplines. Students will work in teams and employ design processes to arrive at a solution. The course will include elements of communications, economic analysis, impacts of engineering, professionalism, and engineering ethics.
K4(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: APSC 200 or APSC 202
Corequisites: MTHE 335 Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 12
Engineering Science 0
Engineering Design 36
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 406  Introduction To Coding Theory  Units: 3.00
NOT OFFERED 2024-2025.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: MTHE 217 (MATH 217)
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
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 418  Number Theory & Cryptography  Units: 3.00
Time estimates for arithmetic and elementary number theory algorithms (division algorithm, Euclidean algorithm, congruences), modular arithmetic, finite fields, quadratic residues. Simple cryptographic systems; public key, RSA. Primality and factoring: pseudoprimes, Pollard's rho-method, index calculus. Elliptic curve cryptography.
NOT OFFERED 2024-2025.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: MTHE 217 (MATH 217) or MATH 210 or MATH 211 with permission of the instructor
Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 18
Natural Sciences 0
Complementary Studies 0
Engineering Science 9
Engineering Design 9
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 430  Control Theory  Units: 4.00
This course covers core topics in both classical and modern control theory. Overview of classical control theory using frequency methods. Linear and nonlinear controlled differential systems and their solutions. Stabilization and stability methods via Lyapunov analysis or linearization. Controllability, observability, minimal realizations, feedback stabilization, observer design. Optimal control theory, the linear quadratic regulator, dynamic programming.
(Lec: 3, Lab: 0.5, Tut: 0.5)
Requirements: Prerequisites: MTHE 237, MTHE 212, MTHE 326, or permission of the instructor
Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 6
Natural Sciences 6
Complementary Studies 0
Engineering Science 18
Engineering Design 18
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 433 Continuum Mechanics with Applications  Units: 3.50
Continuum mechanics lays the foundations for the study of the mechanical behavior of solids and fluids. After a review of vector and tensor analysis, the kinematics of continua are introduced. Emphasis is given to the concepts of stress, strain and deformation. The fundamental laws of conservation of mass, balances of (linear and angular) momentum and energy are presented together with the constitutive models. Applications of these models are given in the theory of linearized elasticity and fluid dynamics.

Requirements: Prerequisites: MTHE 237, MTHE 280, or permission of the instructor
Offering Term: F
CEAB Units:
Mathematics 6
Natural Sciences 0
Complementary Studies 0
Engineering Science 24
Engineering Design 12
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 434 Optimization Theory with Applications to Machine Learning  Units: 3.50
Theory of convex sets and functions; separation theorems; primal-dual properties; geometric treatment of optimization problems; algorithmic procedures for solving constrained optimization programs; applications of optimization theory to machine learning.
NOT OFFERED 2024-2025
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 281 (MATH 281), MTHE 212 (MATH 212), or permission of the instructor
Offering Term: W
CEAB Units:
Mathematics 15
Natural Sciences 0
Complementary Studies 0
Engineering Science 15
Engineering Design 12
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 436 Partial Differential Equations  Units: 3.00
NOT OFFERED 2024-2025.
(Lec: 3, Lab: 0 Tut: 0)
Requirements: Prerequisites: MTHE 237, MTHE 280 or permission of the instructor
Offering Term: F
CEAB Units:
Mathematics 18
Natural Sciences 6
Complementary Studies 0
Engineering Science 12
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 437  Topics In Applied Mathematics Units: 3.50
Topic: An Introduction to Stochastic Differential Equations
(with Applications to Mathematical Finance and Engineering)
The aim of this course is to provide a rigorous introduction
to the theory of stochastic calculus and stochastic differential
equations, and to survey some of its most important
applications, especially in Mathematical Finance. The
Ito stochastic integral and its associated Ito Calculus
will be derived in the general framework of continuous
semimartingales, leading to a detailed treatment of stochastic
differential equations (SDEs) and their properties. The theory
thus developed will be applied to selected problems in
Mathematical Finance (option pricing and hedging, trading
strategies and arbitrage) and Engineering (boundary-value
problems, filtering, optimal control). Numerical aspects of
SDEs will also be discussed.
NOT OFFERED 2024-2025.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 328 and MTHE 351, or
permission of the instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 18
Natural Sciences 0
Complementary Studies 0
Engineering Science 12
Engineering Design 12
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in
the meantime.

MTHE 439  Lagrangian Mechanics, Dynamics
Control Units: 3.50
Geometric modelling, including configuration space, tangent
bundle, kinetic energy, inertia, and force. Euler-Lagrange
equations using affine connections. The last part of the
course develops one of the following three applications:
mechanical systems with nonholonomic constraints; control
time theory for mechanical systems; equilibria and stability.
NOT OFFERED 2024-2025
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 280 (MATH 280),
MTHE 281 (MATH 281), MTHE 237 (MATH 237) or MATH 231,
or permission of the instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 20
Natural Sciences 0
Complementary Studies 0
Engineering Science 11
Engineering Design 11
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in
the meantime.
**MTHE 454 Statistical Spectrum Estimation**  
**Units: 3.00**

Many systems evolve with an inherent amount of randomness in time and/or space. The focus of this course is on developing and analyzing methods for analyzing time series. Because most of the common time-domain methods are unreliable, the emphasis is on frequency-domain methods, i.e., methods that work and expose the bias that plagues most time-domain techniques. Slepian sequences (discrete prolate spheroidal sequences) and multi-taper methods of spectrum estimation are covered in detail.

**NOT OFFERED 2024-2025**

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

**Requirements:** Prerequisites: MTHE 353 (STAT 353), MTHE 312 (MATH 312); or MTHE 338 (MATH 338), STAT 251; or STAT 261, MATH 321; or permission or the instructor

**Corequisites:**

**Exclusions:**

**Offering Term:** W

**CEAB Units:**

Mathematics 12  
Natural Sciences 0  
Complementary Studies 0  
Engineering Science 12  
Engineering Design 12

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

**Course Learning Outcomes:**

1. CLOs coming soon; please refer to your course syllabus in the meantime.

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**MTHE 455 Stochastic Processes & Applications**  
**Units: 3.50**


(Lec: 3, Lab: 0, Tut: 0.5)

**Requirements:** Prerequisites: MTHE 353 (STAT 353) or one of STAT 251, MTHE 351 (STAT 351), ELEC 326 with permission of the instructor

**Corequisites:**

**Exclusions:**

**Offering Term:** F

**CEAB Units:**

Mathematics 28  
Natural Sciences 0  
Complementary Studies 0  
Engineering Science 14  
Engineering Design 0

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

**Course Learning Outcomes:**

1. CLOs coming soon; please refer to your course syllabus in the meantime.

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**MTHE 457 Statistical Learning**  
**Units: 3.00**

Introduction to the theory and application of statistical algorithms. Topics include classification, smoothing, model selection, optimization, sampling, supervised and unsupervised learning.

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

**Requirements:** Prerequisites: MTHE 351 or equivalent

**Corequisites:**

**Exclusions:**

**Offering Term:** W

**CEAB Units:**

Mathematics 12  
Natural Sciences 0  
Complementary Studies 0  
Engineering Science 24  
Engineering Design 0

**Offering Faculty:** Smith Engineering

**Course Learning Outcomes:**

1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 472 Optimization and Control of Stochastic Systems  Units: 3.50
This course concerns the optimization, control, and stabilization of dynamical systems under probabilistic uncertainty with applications in engineering systems and applied mathematics. Topics include: controlled and control-free Markov chains and stochastic stability; martingale methods for stability and stochastic learning; dynamic programming and optimal control for finite horizons, infinite horizons, and average cost problems; partially observed models, non-linear filtering and Kalman Filtering; linear programming and numerical methods; reinforcement learning and stochastic approximation methods; decentralized stochastic control, and continuous-time stochastic control.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 351 or permission of the instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 6
Natural Sciences 0
Complementary Studies 0
Engineering Science 18
Engineering Design 18
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 474 Information Theory  Units: 3.50
Topics include: information measures, entropy, mutual information, modeling of information sources, lossless data compression, block encoding, variable-length encoding, Kraft inequality, fundamentals of channel coding, channel capacity, rate-distortion theory, lossy data compression, rate-distortion theorem.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: STAT 251 or MTHE 351 (STAT 351) or ELEC 326 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 6
Natural Sciences 0
Complementary Studies 0
Engineering Science 23
Engineering Design 13
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MTHE 477 Data Compression and Source Coding: Theory and Algorithms  Units: 3.00
Topics include: arithmetic coding, universal lossless coding, Lempel-Ziv and related dictionary based methods, rate-distortion theory, scalar and vector quantization, predictive and transform coding, applications to speech and image coding.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: MTHE 474 (MATH 474) Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 21
Engineering Design 15
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 478  Topics In Communication Theory  Units: 3.00  
Subject matter will vary from year to year. Possible subjects include: constrained coding and applications to magnetic and optical recording; data compression; theory and practice of error-control coding; design and performance analysis of communication networks; and other related topics.  
NOT OFFERED 2024-2025  
(Lec: 3, Lab: 0, Tut: 0)  
Requirements: Prerequisites: Permission of the instructor  
Corequisites: Exclusions:  
Offering Term: FW  
CEAB Units:  
Mathematics 0  
Natural Sciences 0  
Complementary Studies 0  
Engineering Science 18  
Engineering Design 18  
Offering Faculty: Faculty of Arts and Science  
Course Learning Outcomes:  
1. CLOs coming soon; please refer to your course syllabus in the meantime.  

MTHE 484  Data Networks  Units: 3.00  
This course covers performance models for data networking, delay models and loss models; analysis of multiple access systems, routing, and flow control; multiplexing; priority systems; satellite multiple access, wireless networking, wireless sensor networks. Knowledge of networking protocols is not required.  
NOT OFFERED 2024-2025.  
(Lec: 3, Lab: 0, Tut: 0)  
Requirements: Prerequisites: MTHE 455 (STAT 455) or permission of the instructor  
Corequisites: Exclusions:  
Offering Term: W  
CEAB Units:  
Mathematics 10  
Natural Sciences 0  
Complementary Studies 10  
Engineering Science 26  
Engineering Design 0  
Offering Faculty: Faculty of Arts and Science  
Course Learning Outcomes:  
1. CLOs coming soon; please refer to your course syllabus in the meantime.  

MTHE 493  Engineering Math Project  Units: 7.50  
This is the capstone design course for Mathematics and Engineering. Students must work in groups. Projects are selected early in the year from a list put forward by Mathematics and Engineering faculty members who will also supervise the projects. There is a heavy emphasis on engineering design and professional practice. All projects must be open-ended and design oriented, and students are expected to undertake and demonstrate, in presentations and written work, a process by which the design facets of the project are approached. Projects must involve social, environmental, and economic factors, and students are expected to address these factors comprehensively in presentations and written work. Students are assessed individually and as a group on their professional conduct during the course of the project.  
K7.5(Lec: No, Lab: Yes, Tut: Yes)  
Requirements: Prerequisites: MTHE 393 and must be registered in BSCE or BASC program. Corequisites: Exclusions:  
Offering Term: FW  
CEAB Units:  
Mathematics 0  
Natural Sciences 0  
Complementary Studies 10  
Engineering Science 10  
Engineering Design 70  
Offering Faculty: Faculty of Arts and Science  
Course Learning Outcomes:  
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MTHE 494  Mathematics and Engineering Seminar  Units: 3.00
This is a seminar course, with an emphasis on communication skills and professional practice. A writing module develops technical writing skills. Students give an engineering presentation to develop their presentation skills. Seminars are given by faculty from the Mathematics and Engineering program, by Mathematics and Engineering alumni on the career paths since completing the program, and by visiting speakers on a variety of professional practice matters, on topics such as workplace safety, workplace equity and human rights, and professional organizations. Open to Mathematics and Engineering students only.
(Lec: 3, Lab: 0, Tut: 0)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 26
Engineering Science 10
Engineering Design 0
Offering Faculty: Faculty of Arts and Science
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.