FACULTY OF SCIENCE
Department of Mathematics and Statistics

Mathematics 601 Measure and Integration

Calendar Description: abstract measure theory, basic integration theorems, Fubini's Theorem, Radon-Nikodym theorem, L^p spaces, Riesz representation theorem.

Prerequisites: Mathematics 445 or 447 or consent of Department

Antirequisite: Mathematics 501

Textbook: P. Billingsley, Probability and Measure

(see Course Descriptions under the year applicable: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics:	**Number of Hours**
Measure and measure spaces, sigma-algebras, measurable functions, extension and uniqueness, construction of Lebesgue measure on the reals, finite measures and probability, product measures	9
Integration, simple functions, approximation of measurable functions by simple functions, dominated and monotone convergence theorems, Fubini theorem	9
L^p spaces, L^p norm, completeness, separability, L^2 as a Hilbert space, Holder, Cauchy-Swartz and Minkowski inequalities	6
Different modes of convergence, uniform integrability, convergence in probability, L^p convergence, weak and almost sure convergence; convergence in distributions, laws of large numbers .	6
Sigma-finite measures, Hahn decomposition, absolute continuity, Radon-Nikodym theorem, conditional expectations	6
TOTAL:	**36**

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Mathematics 603 Analysis III

Calendar Description: sequences and series of functions, Lebesgue integration on the line, Fourier series and the Fourier transform, pointwise convergence theorems, distributions and generalized functions.

Prerequisites: Mathematics 447 or a grade of “B+” or better in Mathematics 445 or consent of Department

Antirequisite: Pure Mathematics 545 and Mathematics 545

Textbook: W. Rudin, Real and Complex Analysis

(see Course Descriptions under the year applicable: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics:	**Number of Hours**
Sequences and series of functions, pointwise and uniform convergence, Weierstrass M-test	6
Step functions and their integrals, integration of limits of increasing sequences of step functions, the Lebesgue integral and its basic properties, sets of measure zero, the monotone and dominated convergence theorems, Fatou’s lemma, functions defined by integrals and differentiation under the integral sign, Fubini’s theorem, square-integrable functions, completeness of L^2, L^p spaces, Hilbert space axioms, the Hilbert space l^2, Fourier series as an isometry of L^2 with l^2, Riesz representation theorem, self-duality of Hilbert spaces.	15
The Fourier series of a function, Parseval’s formula, the Riesz-Fischer theorem, the L^2-density of trigonometric polynomials, Riemann-Lebesgue lemma, pointwise convergence of Fourier series.	6
The Fourier transform and its properties, the Fourier integral theorem, distributions, convolution and the Fourier transform, the Laplace transform, applications to differential equations.	9
TOTAL:	**36**

Time permitting, may include Arzela-Ascoli theore, construction of nowhere differentiable functions, Dirac delta function and its Fourier transform, etc.

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Department of Mathematics and Statistics

Mathematics 605 Differential Equations III

Calendar Description: Systems of ordinary differential equations. Existence and uniqueness. Introduction to partial differential equations.

Prerequisites: Applied Mathematics 411 and Mathematics 445 or 447 or consent of Department

Antirequisite: Applied Mathematics 605

Textbooks:

P, Hartman, Ordinary Differential Equations, Wiley
W. A. Strauss, Partial Differential Equations, an introduction", second ed, Wiley.

(see Course Descriptions under the year applicable: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics:	**Number of Hours**
Existence and uniqueness of solutions of ordinary differential equations.	3
Dependence on initial conditions and parameters.	2
Linear systems. Systems with periodic coefficients, Floquet theory, periodic solutions, stability.	8
Nonlinear systems. Poincaré-Bendixson theory, qualitative analysis, stability, linearization.	8
Partial differential equations: first order equations, the Cauchy-Kowalewski theorem. Classification of second order equations: hyperbolic, elliptic and parabolic.	9
Optional topics: boundary value problems, asymptotics, chaos and global analysis of ordinary differential equations, distributions, weak solutions, or the choice of the instructor.	6
TOTAL:	**36**

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Mathematics 607 — Algebra III

Calendar Description: A sophisticated introduction to modules over rings, especially commutative rings with identity. Major topics include: snake lemma; free modules; tensor product; hom-tensor duality; finitely presented modules; invariant factors; free resolutions; and the classification of finitely generated modules over principal ideal domains. Adjoint functors play a large role. The course includes applications to linear algebra, including rational canonical form and Jordan canonical form.

Prerequisites: Pure Mathematics 431 or Mathematics 411 or consent of Department.

Note: Pure Mathematics 431 is recommended.

Antirequisite: Pure Mathematics 511 and Pure Mathematics 611

Textbook: Hungerford, Algebra

(see Course Descriptions under the year applicable: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics:	**Number of Hours**
Recap of rings and ideals; isomorphism theorem	3
Integral domains; maximal and prime ideals; principal ideal domains (PIDs)	3
The ascending chain condition; unique factorization in PIDs	3
Modules over rings; submodules; quotient modules; linear transformations and kernels	3
Direct sums of modules; free modules; basis and rank; the matrix of a linear transformation	3
Tensor product; extension of scalars	3
Symmetric and alternating products; determinants	3
Cyclic and torsion modules over PIDs	3
The structure of finite abelian groups; canonical forms of matrices	3
Finitely generated modules over PIDs; invariant factors	3
Presentations of modules; computing invariant factors	3
Exact sequences; hom and tensor functors and their adjointness, left and right exactness	3
TOTAL:	**36**

Time permitting: Projective, injective and flat modules

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