INTEGRATED APPLIED MATHEMATICS (IAM)

Course numbers with the # symbol included (e.g. #400) have not been taught in the last 3 years.

IAM 830 - Graduate Ordinary Differential Equations
Credits: 3
Course is a graduate-level course on ordinary differential equations. It is designed to be accessible to first-year graduate students from math, science or engineering backgrounds who have had a first undergraduate course in differential equations, along with a standard calculus sequence. The course is designed to begin with an intensive review of undergraduate differential equations and then will proceed to handle more advanced concepts, starting with multi-dimensional coupled systems of ordinary differential equations, exponential matrix solutions, using coordinate transformations for conversion to standard forms, nonlinear systems and transform-based solutions, using coordinate transformations for conversion to standard forms, nonlinear systems and transform-based techniques. The course will have an interdisciplinary and applied style and will cover the following topics: Intense review of undergraduate differential equations, Power Series and Fourier Series solutions, Multi-dimensional D.E.s, eigenvectors and Jordan forms, Numerical Methods, Nonlinear D.E.s Dynamical Systems and Chaos.
Grade Mode: Letter Grading

IAM 851 - Introduction to High-Performance Computing
Credits: 3
Course gives an introduction to select areas of high-performance computing, providing a basis for writing and working with high-performance simulation codes. The three main topics are: 1) basic software engineering, 2) high-performance and parallel programming, and 3) performance analysis and modeling. Additional topics may include heterogeneous architectures like GPUs and data analysis/visualization. Working knowledge of a compiled programming language (C, C++ or Fortran) is required prior to taking this course.
Grade Mode: Letter Grading

IAM 932 - Graduate Partial Differential Equations
Credits: 3
Graduate level introduction to the analysis of linear and nonlinear partial differential equations. topics include: separation of variables, Fourier series, weak and strong solutions, eigenfunction expansions, the Strum-Liouville problem, Green's functions and fundamental solutions, method of characteristics, and conservation laws. A solid foundation in Ordinary Differential Equations and Linear Algebra is required prior to taking this course.
Grade Mode: Letter Grading

IAM 933 - Applied Functional Analysis
Credits: 3
Introduction to rigorous mathematical analysis from the perspective of applications. Topics include: metric and normed spaces; convergence; completeness; continuity; Lebesgue measure theory; convergence theorems; Banach, Hilbert, Lp, and Sobolev spaces; orthogonality, bases, and projections; Sturm-Liouville theory; spectral theory; distributions; and weak solutions. Applications including to differential and integral equations, are presented throughout. Knowledge of real analysis is required, or graduate level introductory courses in mathematical physics or applied mathematics should be taken prior to taking this course.
Grade Mode: Letter Grading

IAM 940 - Asymptotic and Perturbation Methods
Credits: 3
Introduction to the asymptotic analysis of linear and nonlinear algebraic equations, ODEs, and PDEs and the asymptotic approximation of integrals arising as transform solutions to ODEs/PDEs. Topics include: algebraic equations and dominant balance; asymptotic approximations; complex variable theory and the asymptotic evaluation of integrals via Laplace's method, stationary phase, and steepest descents; the method of matched asymptotic expansions (boundary-layer theory), coordinate straining, multiple scales, averaging, homogenization theory, and WKBJ analysis for singularly perturbed ODEs and PDEs.
Grade Mode: Letter Grading

IAM 945 - Pattern Formation
Credits: 3
Patterns arise spontaneously in myriad systems. This course provides an introduction to pattern formation theory in nonlinear forced-dissipative PDEs. Mathematical tools including linear, secondary, and energy stability analysis, Floquet theory, and multiple-scale and WKBJ asymptotic analysis will be introduced to develop quantitative theories of weakly and strongly nonlinear patterns. Applications will be drawn from fluid mechanics, biology, and ecology, among other areas.
Grade Mode: Letter Grading

IAM #950 - Spatiotemporal and Turbulent Dynamics
Credits: 3
Advanced graduate course on the dynamics of spatiotemporal patterns in nonlinear time-dependent PDEs. Topics include nonlinear pattern formation, bifurcations and symmetry, nonlinear WKB analysis, phase diffusion/amplitude modulation theory, unstable coherent structures in turbulence, and periodic orbit theory. Example systems include 1d and 2d Swift-Hohenberg equation, the 1d Kuramoto-Sivashinsky equation, Rayleigh-Benard convection, and Navier-Stokes in plane Couette and pipe flows. Knowledge of nonlinear dynamics is required prior to taking this course.
Grade Mode: Letter Grading

IAM 961 - Numerical Analysis I: Numerical Linear Algebra
Credits: 3
Introduction to numerical analysis and computational methods for linear systems. Topics include: IEEE floating point arithmetic; vector norms and induced norms; conditioning; projectors; LU decompositions; pivoting; Cholesky factorization; QR decompositions; Gram-Schmidt orthogonalization; Householder triangularization; Singular Value decompositions; least squares problems; stability; eigenvalue problems; power iterations; QR algorithm; Krylov methods; Arnoldi iteration; GMRES; Lanczos iteration; Conjugate gradient algorithms; and Preconditioning. Knowledge of computer programming and linear algebra is required prior to taking this course.
Grade Mode: Letter Grading

IAM 962 - Numerical Partial Differential Equations
Credits: 3
Numerical analysis applied to partial differential equations. Initial topics include the implementation of finite difference and spectral methods applied to the heat equation, wave equation, Burger's equation, and other model equations. The remainder of the course treats numerical analysis, starting with a brief review of function spaces. The primary topics include approximation theory for Sobolev spaces, projection operators, completeness, convergence, and error estimates.
Grade Mode: Letter Grading

IAM 995 - IAM Special Topics
Credits: 1-4
Investigations of graduate-level problems or topics in Integrated Applied Mathematics. May be repeated barring duplication of subject.
Repeat Rule: May be repeated up to unlimited times.
Grade Mode: Letter Grading

IAM 998 - Independent Study/Reading Course
Credits: 1-4
Independent investigation of graduate-level problems or topics in Integrated Applied Mathematics under the guidance of a faculty member. May be repeated barring duplication of subject.
Repeat Rule: May be repeated up to unlimited times.
Grade Mode: Letter Grading

IAM 999 - Doctoral Research
Credits: 0
Doctoral Research.
Grade Mode: Graduate Credit/Fail grading