# Department of Mathematics

# 2013 - Spring semester

## I. GRADUATE COURSE CATALOG

## II. GRADUATE COURSE SPRING 2013 - (01/14/2013 - 05/10/2013 )

### SENIOR UNDERGRADUATE COURSES

Math 4309 - Section#18398 - Mathematical Biology - by Z. Kilpatrick
Math 4315 - Section#13277 - Graph Theory with Applications - by Fajtlowicz
Math 4332 - Section#13278 - Introduction to Real Analysis - by D. Wagner
Math 4336 - Section#34480 - Partial Differential Equations - by R. Glowinski
Math 4351 - Section#34481 - Differential geometry - by M. Ru
Math 4355 - Section#29421 - Mathematics of Signal Representation - by B. Bodmann
Math 4365 - Section#13279 - Numerical Analysis - by J. Qiu
Math 4377* - Section#16604 - Advanced Linear Algebra I - by A. Quaini
Math 4377 - Section#34486 - Advanced Linear Algebra I - by V. Climenhaga
Math 4378* - Section#13280 - Advanced Linear Algebra II - by A. Torok
Math 4380 - Section#13281 - A Mathematical Introduction to Options - by I. Timofeyev
Math 4389 - Section#13282 - Survey of Undergraduate Mathematics - by S. Branton

### GRADUATE ONLINE COURSES

Math 5330 - Section#15385 - Abstract algebra - by K. Kaiser
Math 5332 - Section#13310 - Differential equations - by G. Etgen
Math 5333 - Section#38588 - Analysis - by G. Etgen
Math 5386 - Section#17638 - Regression and Linear Models - by C. Peters
Math 5397 - Section#34497 - Complex analysis - by S. Ji

### GRADUATE COURSES

Math 6303 - Section#13318 - Modern Algebra - by K. Kaiser
Math 6308* - Section#15660 - Advanced Linear Algebra I- by A. Quaini
Math 6308 - Section#34488 - Advanced Linear Algebra I- by V. Climenhaga
Math 6309* - Section#15661 - Advanced Linear Algebra II - by A. Torok
Math 6313 - Section#15659 - Introduction to Real Analysis - by D. Wagner
Math 6321 - Section#13336 - Theory of Functions of a Real Variable - by Labate
Math 6325 - Section#34510 - Differential Equations - by M. Nicol
Math 6361* - Section#15663 - Applicable Analysis - by Y. Gorb
Math 6367 - Section#13337 - Optimization and Variational Methods - by G. Auchmuty
Math 6371* - Section#13338 - Numerical Analysis - by J. He

Math 6383 - Section#13340 - Probability Models and Mathematical Statistics - by R. Azencott
Math 6385 - Section#6385 - Continuous-Time Models in Finance - by E. Kao
Math 6395 - Section#34511 - Complex Geometry - by G. Heier
Math 6397 - Section#34501 - Programming and Code Development for Scientific Computation - by I. Timefayev
Math 6397 - Section#34503 - Multigrid Method - by M. Olshanskii
Math 6397 - Section#34506 - Group Representation - by A. Torok
Math 6397 - Section#34507 - Stochastic Process - by E. Kao
Math 6397 - Section#34508 - Numerical Methods for Option Pricing in Finance - by R. Hoppe
Math 7321 - Section#34509 - Functional Analysis - by D. Blecher
Math 7350 - Section#13406 - Geometry of Manifolds - by W. Ott

**Note: * : This course also has an online version.**

## III. HOW TO REGISTER COURSES

1. Log in to My UH (People Soft)
2. Select "UH Self-Service"
3. Select "Enrollment"
4. Select "Enrollment: add classes" and choose the semester in which you would like to be enrolled.
5. Enter the specific section number for the class.
6. Continue to add more courses if needed and continue to finish the enrollment process.

## IV. ARCHIVE OF PREVIOUS COURSES

**SENIOR UNDERGRADUATE COURSES**

Math 4309 Mathematical Biology (Section#18398 )

| | |
|---|---|
| Time: | MoWeFr 10:00AM - 11:00AM - Room: SEC 201 |
| Instructor: | Z. Kilpatrick |
| Prerequisites: | Linear Algebra (MATH 2331) and Differential Equations(MATH 3321 or MATH 3331) |
| Text(s): | "Dynamic Models in Biology" by Stephen P Ellner and John Guckenheimer |
| Description: | This course introduces and analyzes a variety of mathematical models of biological systems at the molecular, cellular, and population levels. Applications to enzyme kinetics, population dynamics, gene expression, epidemiology, and neuroscience will all be discussed. Studying these systems will require mathematical techniques of dynamical systems, stochastic processes, pattern formation, and matrix analysis. |

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Math 4315 Graph Theory with Applications (Section#13277 )

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|---|---|
| Time: | MoWeFr 10:00AM - 11:00AM - Room: SEC 204 |
| Instructor: | S. Fajtlowicz |
| Prerequisites: | Discrete Mathematics |
| Text(s): | Lecture Note<br>Recommended Text:<br>"Graph Theory with Applications" by Bondy and Murty (available online) |

COURSE PURPOSE: Introduction to basic concepts of graph theory.

COURSE OBJECTIVES: Upon completion of this course, students will be able to take special credit REU-type or master tutorial degree courses.

COURSE CONTENT:
Origins of graph theory - Eulerian tours and Euler characteristic formula. Hamiltonian tours. Chromatic number. Toroidal graphs and graphs on other surfaces. Planar graphs including applications to fullerenes - a new form of carbon. Four-color conjecture and 5-color theorem. Decision problems and introduction to computational complexity.

Description: Ramsey-like results including discussion of their applications to foundations of mathematics. Erdos' probabilistic methods with applications to Ramsey theory. The first two of the above topics take usually up to three weeks, but they may be covered faster this time, thanks to a discovery made by a computer program Graffiti followed by an idea of Stephanie Mathew - an UH, Chemical Engineering undergraduate. The same program made also conjectures about classical fullerenes that proved to be correct, contrary to an opinion of well-known fullerene expert.

COURSE STRUCTURE:
Each class will start with discussion of homework problems. Although working on these problems is optional, the final grade may be somewhat adjusted for active class participation. Both mandatory tests will be preceded by review sessions in the form of questions and answers.

EVALUATION AND GRADING:
The final grade will be the average of grades received on the first two tests, but active class participation and volunteering solutions of homework problems may be used in the calculation of the final grade to increase it by up to half a point.

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Math 4332 Introduction to Real Analysis (Section#13278 )

Time: MoWeFr 11:00AM - 12:00PM - Room: AH 10
Instructor: D. Wagner
Prerequisites: Math 4331 or consent of instructor.
Text(s): Principles of Mathematical Analysis, Walter Rudin, McGraw-Hill, 3rd Edition.

Description: This course is a continuation of Math 4331. We will cover chapters 7, 9, and 11 of the textbook. These chapters cover the following topics:

Chapter 7: Sequences and series of functions and uniform convergence. Equicontinuous families of functions. The Weierstrass approximation theorem and the Stone-Weierstrass theorem.

Chapter 8: Functions of several variables, the contraction mapping theorem and the inverse and implicit function theorems. Differentiation of Integrals.

Chapter 9: Lebesgue measure and Lebesgue integration for the real line and Euclidean n-space.

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Math 4336 Partial Differential Equations (Section#34480 )

Time: TuTh 10:00AM - 11:30AM - Room: CBB 122
Instructor: R. Glowinski
Prerequisites: Math 4335
Text(s): Partial Differential Equations, Second Edition, by Walter Strauss, John Wiley & Sons, Inc. Pub.

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|---|---|
| Description: | This course is a continuation of MATH 4335. The following topics will be covered: PDEs and boundary value problems in multi-dimensions, Green's functions, Fourier Transform, Spectral methods, Nonlinear conservation laws.<br><br>Content:<br><br>Chapter 7: Green's Identities and Green's Functions<br><br>7.1 Green's First Identity<br>7.2 Green's Second Identity<br>7.3 Green's Functions<br>7.4 Half-Space and Sphere<br><br>Chapter 9: Waves in Space<br><br>9.1 Energy and Causality<br>9.2 The Wave Equation in Space-Time<br>9.3 Rays, Singularities, and Sources<br><br>Chapter 10: Boundaries in the Plane and in Space<br><br>10.1 Fourier's Method, Revisited<br>10.2 Vibrations of a Drumhead<br>10.3 Solid Vibrations in a Ball<br><br>Chapter 11: General Eigenvalue Problems<br><br>11.1 The Eigenvalues Are Minima of the Potential Energy<br>11.2 Computation of Eigenvalues<br>11.3 Completeness<br>11.4 Symmetric Differential Operators<br>11.5 Completeness and Separation of Variables<br>11.6 Asymptotics of the Eigenvalues<br><br>Chapter 12: Distributions and Transforms<br>12.1 Distributions<br>12.2 Green's Functions<br>12.3 Fourier Transform<br>12.4 Source functions<br>12.5 Laplace Transform Techniques<br><br>Chapter 14(optional) Nonlinear PDE |

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Math 4351 Differential geometry (Section#34481 )

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|---|---|
| Time: | MoWe 1:00PM - 2:30PM - Room: SEC 201 |
| Instructor: | M. Ru |
| Prerequisites: | Math4350 |
| Text(s): | Differential Geometry: A first course in curves and surfaces by Prof. Theodore Shifrin at the University of Georgia ( http://www.math.uga.edu/~shifrin/ShifrinDiffGeo.pdf) |

Description: This is a continuation of the study of Differential Geometry from Math 4350. I plan to finish the rest of the chapter 3 in Prof. Theodore Shifrin's book, and cover some advanced topics.

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Math 4355 Mathematics of Signal Representation (Section#29421 )

Time: TuTh 2:30PM - 4:00PM - Room: F 154

Instructor: B. Bodmann

Prerequisites: MATH 2331 and one of the following: MATH 3333, MATH 3334, MATH 3330, MATH 3363. MATH 3321 can be used instead of MATH 2431. Students who wish to enroll without having one of the above junior-level courses are encouraged to discuss it with the instructor. While a prior knowledge of Matlab is not required, be aware thatMatlab will be used for some homework.

Text(s): A first course in wavelets with Fourieranalysis by A. Boggess and F. Narcowich, Wiley, 2nd edition 2009.

Description: This course is a self-contained introduction to a very active area of applied mathematics, the representation of signals and images. The study of such representations is motivated by challenging questions: How can we efficiently and robustly store or transmit an image or a voice signal? How do we remove unwanted noise and artifacts from data? How can we identify features of interests in a signal? Students will learn the basic theory of Fourier series and wavelets which are present in a variety of applications and technologies including image and video compression, electronic surveillance, remote sensing and data transmission.

Topics include: Inner product spaces, Schwarz and triangle inequalities, orthogonal projections and the least squares fit, Fourier series and transform, computation of Fourier series, convergence of Fourier series, convolutions, linear filters, the sampling theorem, analog to digital and digital to analog conversions. analog and digital filters, the Discrete Fourier transform (DFT), FFT, its use for the approximate computation of integral Fourier transforms, the Haar wavelet, Multiresolution Analysis, properties of the scaling function, decomposition and reconstruction algorithms, wavelet design in the frequency domain, the Daubechies wavelet.

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Math 4365 Numerical Analysis II(Section#13279 )

Time: MoWeFr 10:00AM - 11:00AM - Room: AH 10

Instructor: J. Qiu

Prerequisites: Linear algebra (MATH2331) and Differential Equations (MATH 3331), and program experience in Fortran, or C, or Matlab etc. before.

Text(s): Numerical Analysis, 8th edition by Burden and Faires.

Description: This course introduces students to classical numerical methods for approximating the solutions of common mathematical problems. It allows students to deal with numerical methods both at a theoretical level and for programming purposes. This is an introductory course and will be a mix of mathematics and computing. The mathematical content of the course for this semester will be focused on numerical methods for ordinary differential equations and partial differential equations.

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Math 4377 Advanced Linear Algebra I (Section#16604 )

Time: MoWeFr 12:00PM - 1:00PM - Room: CBB 110

Instructor: A. Quaini

Prerequisites: Math 2331 and minimum 3 hours of 3000 level mathematics.

Text(s): Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, ISBN 0-13-008451-4

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| Description: | This is a proof-based course. It will cover Chapters 1-4 and the first two sections of Chapter 5. Topics include systems of linear equations, vector spaces and linear transformations (developed axiomatically), matrices, determinants, eigenvectors and diagonalization. |
| Remark: | **This course is taught in classroom, but can also be taken as an online course (to do this, you need to contact the instructor).** |

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Math 4377 Advanced Linear Algebra I (Section#34486 )

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|---|---|
| Time: | TuTh 4:00PM - 5:30PM - Room: SEC 201 |
| Instructor: | V. Climenhaga |
| Prerequisites: | Math 2331 and a minimum of three semester hours of 3000-level mathematics. |
| Text(s): | Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, ISBN 0-13-008451-4 |
| Description: | This is a proof-based course covering systems of linear equations, vector spaces and linear transformations (developed axiomatically), matrices, determinants, eigenvalues, eigenvectors, and diagonalisation. |

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Math 4378 Advanced Linear Algebra II (Section#13280 )

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|---|---|
| Time: | TuTh 10:00AM - 11:30AM - Room: GAR 201 |
| Instructor: | A. Torok |
| Prerequisites: | Math 4377 (or Math 6308) |
| Text(s): | Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, ISBN 0-13-008451-4 |
| Description: | The instructor will cover Sections 5-7 of the textbook. Topics will include: Eigenvalues/Eigenvectors, Cayley-Hamilton Theorem, Inner Products and Norms, Adjoints of Linear Operators, Normal and Self-Adjoint Operators, Orthogonal and Unitary Operators, Jordan Canonical Form, Minimal Polynomials, Rational Canonical Form |
| Remark: | **This course is taught in classroom, but can also be taken as an online course (to do this, you need to contact the instructor).** |

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Math 4380 A Mathematical Introduction to Options (Section#13281 )

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|---|---|
| Time: | MoWeFr 12:00PM - 1:00PM - Room: C 111 |
| Instructor: | I. Timofeyev |
| Prerequisites: | Math 3338 (Probability) and Math 2433 (Calculus III) |
| Text(s): | "An Introduction to Financial Option Valuation: Mathematics, Stochastics and Computation" by Desmond Higham |
| Description: | This course is an introduction to mathematical modeling of various financial instruments, such as options, futures, etc. The topics covered include: calls and puts, American and European options, expiry, strike price, drift and volatility, non-rigorous introduction to continuous-time stochastic processes including Wiener Process and Ito calculus, the Greeks, geometric Brownian motion, Black-Scholes theory, binomial model, martingales, filtration, and self financing strategy. |

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Math 4389 Survey of Undergraduate Mathematics (Section#13282 )

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|---|---|
| Time: | |
| Instructor: | S. Branton |
| Prerequisites: | |
| Text(s): | |

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| Description: | A review of some of the most important topics in the undergraduate mathematics curriculum including analysis, algebra, differential equations, linear algebra, and probability and statistics.<br><br>This course is approved for three hours credit forward the NS&M Capstone requirement. At the end of the course students will be required to take the Major Field Test in Mathematics. Students may not receive an A in the course without scoring at or above the national median on the test. |

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**GRADUATE ONLINE COURSES**

Math 5330 Abstract algebra (Section#15385 )

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|---|---|
| Time: | Arrange (online course) |
| Instructor: | K. Kaiser |
| Prerequisites: | Acceptance into the MAM program; post bachelor standing |
| Text(s): | Dan Saracino, Abstract Algebra, A first course, first or second edition |
| Description: | Introduction to groups, rings and fields.<br>Additional notes will be made available on http://www.math.uh.edu/%7eklaus/ |

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Math 5332 Differential equations (Section#13310 )

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|---|---|
| Time: | Arrange (online course) |
| Instructor: | G. Etgen |
| Prerequisites: | MATH 5331 and consent of instructor. |
| Text(s): | |
| Description: | Linear and nonlinear systems of ordinary differential equations; existence, uniqueness and stability of solutions; initial value problems; higher dimensional systems; Laplace transforms. Theory and applications illustrated by computer assignments and by projects. This course will apply toward the Master of Arts in Mathematics degree; it will not apply toward the Master of Science in Mathematics or the Master of Science in Applied Mathematics degrees.<br>**Remark:**<br>**If you are a MA graduate student wanting to enroll for this course, in case the quota is full or any problem, please contact Dr. Etgen at etgen@math.uh.edu and he will help you.** |

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Math 5333 Analysis (Section#38588 )

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|---|---|
| Time: | Arrange (online course) |
| Instructor: | G. Etgen |
| Prerequisites: | |
| Text(s): | |
| Description: | The real number system and the topology of the real line, including completenesss and compactness; sequences of real numbers and convergence; limits of functions, continuous functions and uniform continuity; differentiation, the mean-value theorem, L'Hopital's rule and Taylor's theorem; the Riemann integral, properties of the definite integral, the fundamental theorem of calculus. |

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Math 5386 Regression and Linear Models (Section#17638 )

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|---|---|
| Time: | Arrange (online course) |
| Instructor: | C. Peters |
| Prerequisites: | Math 5385 or equivalent |
| Text(s): | Intro. to Linear Regression Analysis, 5th ed., Montgomery, Vining and Peck, Wiley 2012. |
| Description: | Simple and multiple linear regression, regression diagnostics, transformations, nonparametric and robust methods, model building, generalized linear models. This course involves a significant amount of computing using R or a similar package. |

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Math 5397 Complex analysis (Section#34497 )

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|---|---|
| Time: | Arrange (online course) |
| Instructor: | S. Ji |
| Prerequisites: | Math 5333 or 3333, or consent of instructor. |
| Text(s): | Instructor's lecture notes. |
| Description: | This course is an introduction to complex analysis. It will cover the theory of holomorphic functions, Cauchy theorem and Cauchy integral formula, residue theorem, harmonic and subharmonic functions, and other topics.<br><br>On-line course is taught through Blackboard Vista, visit http://www.uh.edu/webct/ for information on obtaining ID and password.<br><br>The course will be based on my notes.<br><br>In each week, some lecture notes will be posted in Blackboard Vista, including homework assignment.<br><br>Homework will be turned in by the required date through Blackboard Vista. It must be in pdf file.<br><br>Homework and test problems are mostly computational in nature |

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**GRADUATE COURSES**

Math 6303 Modern Algebra (Section#13318 )

| | |
|---|---|
| Time: | TuTh 11:30AM - 1:00PM - Room: F 162 |
| Instructor: | K Kaiser |
| Prerequisites: | Graduate standing; previous exposure to senior or graduate algebra, for example Math 6302 |
| Text(s): | Thomas W. Hungerford, Algebra; My own course notes available on http://www.math.uh.edu/%7eklaus/ |
| Description: | Modules over Principal Ideal Domains with applications to finitely generated abelian groups and normal forms of matrices; Sylow theory, Universal algebraic constructions, like co-products, ultraproducts and ultrapowers of the real numbers. |

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Math 6308 Advanced Linear Algebra I (Section#15660 )

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|---|---|
| Time: | MoWeFr 12:00PM - 1:00PM - Room: CBB 110 |
| Instructor: | A. Quaini |

Prerequisites: Math 2331 and minimum 3 hours of 3000 level mathematics.
Text(s): Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, ISBN 0-13-008451-4
Description: This is a proof-based course. It will cover Chapters 1-4 and the first two sections of Chapter 5. Topics include systems of linear equations, vector spaces and linear transformations (developed axiomatically), matrices, determinants, eigenvectors and diagonalization.
Remark: There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options.
**This course is taught in classroom, but can also be taken as an online course (to do this, you need to contact the instructor).**

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Math 6308 Advanced Linear Algebra I (Section#34488 )

Time: TuTh 4:00PM - 5:30PM - Room: SEC 201
Instructor: V. Climenhaga
Prerequisites: Math 2331 and a minimum of three semester hours of 3000-level mathematics.
Text(s): Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, ISBN 0-13-008451-4
Description: This is a proof-based course covering systems of linear equations, vector spaces and linear transformations (developed axiomatically), matrices, determinants, eigenvalues, eigenvectors, and diagonalisation.
Remark: There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options.

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Math 6309 Advanced Linear Algebra II (Section#15661 )

Time: TuTh 10:00AM - 11:30AM - Room: GAR 201
Instructor: A. Torok
Prerequisites: Math 4377 (or Math 6308)
Text(s): Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, ISBN 0-13-008451-4
Description: The instructor will cover Sections 5-7 of the textbook. Topics will include: Eigenvalues/Eigenvectors, Cayley-Hamilton Theorem, Inner Products and Norms, Adjoints of Linear Operators, Normal and Self-Adjoint Operators, Orthogonal and Unitary Operators, Jordan Canonical Form, Minimal Polynomials, Rational Canonical Form
Remark: There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options.
**This course is taught in classroom, but can also be taken as an online course (to do this, you need to contact the instructor).**

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Math 6313 Introduction to Real Analysis (Section#15659 )

Time: MoWeFr 11:00AM - 12:00PM - Room: AH 10
Instructor: D. Wagner
Prerequisites: Math 4331 or consent of instructor.
Text(s): Principles of Mathematical Analysis, Walter Rudin, McGraw-Hill, 3rd Edition.

| | |
|---|---|
| Description: | This course is a continuation of Math 4331. We will cover chapters 7, 9, and 11 of the textbook. These chapters cover the following topics:<br><br>Chapter 7: Sequences and series of functions and uniform convergence. Equicontinuous families of functions. The Weierstrass approximation theorem and the Stone-Weierstrass theorem.<br><br>Chapter 8: Functions of several variables, the contraction mapping theorem and the inverse and implicit function theorems. Differentiation of Integrals.<br><br>Chapter 9: Lebesgue measure and Lebesgue integration for the real line and Euclidean n-space. |
| Remark: | There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options. |

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Math 6321 Theory of Functions of a Real Variable (Section#13336 )

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|---|---|
| Time: | MoWeFr 11:00AM - 12:00PM - Room: C 102 |
| Instructor: | D. Labate |
| Prerequisites: | MATH 6320 or an equivalent course in measure theory and Lebesgue integration. |
| Text(s): | "Lebesgue Integration on Euclidean Space" (Revised Ed.), by Frank Jones.<br>Publisher: Jones and Bartlett Books in Mathematics, 2000. Additional reading material will be provided by the instructor. |
| Description: | This is the second semester of a two-semester sequence in graduate real analysis. After covering measure theory and Lebesgue integration during the first semester, this semester will be devoted mostly to the following topics: Lp spaces and Hilbert spaces, convolutions, Fourier transform and Fourier series, differentiation.<br><br>Course outline:<br>Lp spaces and Hilbert spaces<br>Abstract measures<br>Convolution<br>Fourier transform and Fourier series<br>Differentiation |

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Math 6325 Differential Equations (Section#34510 )

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|---|---|
| Time: | TuTh 11:30AM - 1:00PM - Room: AH 2 |
| Instructor: | M. Nicol |
| Prerequisites: | Math 6322 or Consent of Professor |
| Text(s): | Recommended Texts:<br>- Mathematics Methods of Classical Mechanics, by V. I. Arnold,Springer Verlag, 2nd edition.<br>- Classical Mechanics, by H. Goldstein, Addison Wesley, 2nd edition. |
| Description: | This course is an introduction to applications of mathematics (in the guise of differential equations theory) to the natural sciences, in particular classical mechanics. Topics covered include Newtonian mechanics (energy, momentum, planetary motion), Lagrangian and Hamiltonian mechanics and Hamilton-Jacobi theory. Applications will include special relativity, fluid dynamics, wave mechanics and rigid body motion. Along the way topics such as differential forms, manifolds, Lie groups and Lie algebras, symplectic geometry and ideas from dynamical systems and ergodic theory will be naturally introduced. |

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Math 6361 Applicable Analysis (Section#15663 )

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|---|---|
| Time: | TuTh 10:00AM - 11:30AM - Room: CBB 214 |
| Instructor: | Y. Gorb |
| Prerequisites: | Math 4331-32, or equivalent or consent of instructor. The course is independent of Math 6360. |
| Text(s): | Dr. Auchmuty's lecture notes on Finite Dimensional Optimization Theory and<br>L.D. Berkowitz, Convexity and Optimization in Rn , Wiley Interscience, 2002. |
| Description: | This course will cover theoretical topics in finite dimensional optimization theory. An introduction to the theory of convex sets and functions, convex constrained optimization, conjugate functions and duality will be given, and linear eigenvalue problems will be studied. Both unconstrained and constrained optimization problems will be handled, and basic applications are considered. |
| Remark: | **This course is taught in classroom, but can also be taken as an online course (to do this, you need to contact the instructor).** |

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Math 6367 Optimization and Variational Methods (Section# 13337)

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|---|---|
| Time: | TuTh 4:00PM - 5:30PM - Room: C 108 |
| Instructor: | G. Auchmuty |
| Prerequisites: | Math 4331-2 and Math 4377-8 or equivalent. This course is independent of M6366 |
| Text(s): | There is no required text for the course.<br>Two reference books that cover similar material are:<br>- Donald R. Smith, "Variational Methods in Optimization", Dover 1998.<br>- John L. Troutman, "Variational Calculus and Optimal Contro"l (2ndedition), Springer 1996. |
| Description: | This course will cover topics in the classical calculus of variations for 1-dimensionalintegrals. First the variational characterization of boundary value problems for ordinarydifferential equations will be described. Criteria for solutions to be local minimizers will be treated. Hamiltonian theory and duall problems will be discussed. Some constrainedproblems will be studied and the theory of Lagrange multipliers and the spectral theory of Sturm-Liouville problems will be covered. Green's functions and equivalent integralequations will be studied. Then some control problems for ordinary differential equations will be treated including some introductory optimal control theory. |

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Math 6371 Numerical Analysis (Section# 13338 )

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|---|---|
| Time: | TuTh 1:00PM - 2:30PM - Room: SEC 206 |
| Instructor: | J. He |
| Prerequisites: | This is the second semester of a two semester course. The first semester is not a prerequisite, but familiarity with numerical solution of linear system is assumed. Familiarity with Matlab is also required |
| Text(s): | 1. Numerical Methods in Scientific Computing, Volume 1<br>Society for Industrial Mathematics (September 4, 2008)<br>Germund Dahlquist, Ake Bjorck<br>ISBN 978-0-898716-44-3<br><br>2. A First Course in the Numerical Analysis of Differential Equations, 2nd Edition<br>Cambridge University Press; 2nd edition (December 29, 2008)<br>Arieh Iserles<br>ISBN 978-0-521734-90-5 |

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| | This is the second semester of a two semester course. The focus in this semester is on approximation theory and numerical analysis of both ordinary and partial differential equations. |
| Description: | The applications of approximation theory to interpolation, Fourier analysis, numerical differentiation and Gaussian integration will be addressed. The concepts of consistency, convergence, stability for the numerical solution of ODEs will be discussed. Other topics covered include multistep and Runge-Kutta methods; finite difference and finite elements techniques for the Poisson equation; and a variety of algorithms to solve large, sparse algebraic systems. |
| Remark: | **This course is taught in classroom, but can also be taken as an online course (to do this, you need to contact the instructor).** |

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Math 6383 Probability Models and Mathematical Statistics (Section#13340 )

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|---|---|
| Time: | TuTh 2:30PM - 4:00PM - Room: CBB 214 |
| Instructor: | R. Azencott |
| Prerequisites: | Undergraduate probability + basic knowledge of "Matlab"or "R" or other scientific programming language |
| Text(s): | Lecture Notes will be handed out for the first 16 lectures<br><br>Complementary Reading Assignments will refer to the contents of specific chapters extracted from<br><br>Undergraduate level :<br>- "Introductory Probability" by Sheldon Ross<br>- "Statistics" by David Freemann, Robert Pisani, Roger Purves<br><br>graduate level<br>- "Intermediary course in probability " by Allan Gut<br>- " Statistics ..." by G. Casella |
| Description: | COURSE OBJECTIVES:<br>Upon completion of the course, students will have learned key results and mathematical principles for the use of parametric models in applied statistics. At least one applied project will involve basic computer implementations of statistical techniques<br><br>COURSE CONTENT:<br>descriptive statistics, statistical sampling and estimation, exponential families and sufficient statistics, maximum likelihood estimators, confidence intervals and hypothesis testing, regression and linear models multiple examples of applied statistics<br><br>COURSE REQUIREMENTS:<br>Written homework assignments + computer implementation of basic statistical techniques<br>Exams: There will be a midterm exam (1h30) and a final exam (3 hours).<br><br>EVALUATION AND GRADING:<br>Semester grades will be based on a weightedaverage of homework +projects average, midterm exam grade, and final exam grade. letter grades correspond to the standard scale: 90-100 for an A, 80-89 for a B, etc. Pluses and minuses will be attached if your average is within two points of the dividing line between one letter and another. Forexample, a grade of 88 is a B+; a grade of 81 is a B-. |

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Math 6385 Continuous-Time Models in Finance (Section#13341 )

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| Time: | TuTh 4:00PM - 5:30PM - Room: C 110 |
| Instructor: | E. Kao |
| Prerequisites: | |
| Text(s): | Arbitrage Theory in Continuous Time, 3rd edition, by Tomas Bjork, Oxford, University Press, 2009. |
| Description: | The course is an introduction to continuous-time models in finance. We first cover tools forpricing contingency claims. They include stochastic calculus, Brownian motion, change of measures, and martingale representation theorem. We then apply these ideas in pricing financial derivatives whose underlying assets are equities, foreign exchanges, and fixed income securities. In addition, we will study the single-factor and multi-factor HJM models, and models involving jump diffusion and mean reversion. |

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Math 6395 Complex Geometry (Section#34511 )

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|---|---|
| Time: | TuTh 1:00PM - 2:30PM - Room: AH 301 |
| Instructor: | G. Heier |
| Prerequisites: | Math 6322-6323, or equivalent |
| Text(s): | Principles of Algebraic Geometry, by Griffiths-Harris<br>Algebraic Geometry--A First Course, by Harris |
| Description: | We will discuss various topics in higher dimensional complex geometry, such as: complex manifolds and varieties, sheaves and cohomology, divisors and line bundles, positivity, curvature, vanishing theorems, algebraic curves, Kodaira's classification of surfaces, birational geometry, resolution of singularities, moduli theory. |

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Math 6397 Programming and Code Development for Scientific Computation (Section#34501 )

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|---|---|
| Time: | MoWeFr 10:00AM - 11:00AM - Room: F 162 |
| Instructor: | I. Timefayev |
| Prerequisites: | Elementary Numerical Analysis. Knowledge of C/Fortran/Matlab |
| Text(s): | instructor's lecture note |
| Description: | We will discuss code development in the context of particular applications with emphasis on computing statistical properties of chaotic and stochastic models. Computing Equilibrium and non-Equilibrium properties of ODEs and Markov chains. Simulating SDEs with Brownian motion and cellular automata models. Kinetic Monte-Carlo algorithm, importance sampling. |

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Math 6397 Multigrid Method (Section# 34503 )

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|---|---|
| Time: | MoWeFr 12:00PM - 1:00PM - Room: SEC 202 |
| Instructor: | M. Olshanskii |
| Prerequisites: | Calculus, Linear Algebra, Numerical Analysis |
| Text(s): | M.A.Olshanskii "Lecture notes on multigrid methods" Moscow: INM RAS, 2012(available free online)<br>Optional text: W. Hackbusch: Multi-Grid Methods and Applications, Springer, 1985 |

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| Description: | The multigrid method is a powerful tool to solve algebraic systems of equations arising in many applications and is known to be among a few methods to provide an optimal complexity in terms of arithmetic operations per unknown. Pioneered in the 70s multigrid soon become a crucial ingredient in engineering software.<br><br>Nowadays, every researcher working with the numerical solution of partial differential equations should at least be familiar with this powerful approach. This course introduces to multigrid methods and their applications in computational physics. We shall study geometric multigrid methods, including classical V- and W-cycles as well as additive multigrid methods and algebraic multigrids. Applications will be considered to basic PDEs as well as to various fluids models, and Maxwell equations.<br><br>The course complements standard numerical analysis (Math 4364), Partial Differential Equations (Math 4335), Advanced Linear Algebra I & II (Math 4377 - 4378). The latter two courses are desirable, but not pre-requested though, since elementary introduction to necessary concepts will be given.<br><br>The final grade will be based on accomplishment of homework assignments. |

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Math 6397 Group Representation (Section#34506 )

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|---|---|
| Time: | TuTh 2:30PM - 4:00PM - Room: AH 301 |
| Instructor: | A. Torok |
| Prerequisites: | Graduate standing |
| Text(s): | http://www.math.uh.edu/~torok/math_6397_Groups/<br>Additional material will be handed out or placed on reserve in the library. |
| Description: | This course will start with the representation theory of finite groups:<br>induced representations, irreducible representations, the left regular representation, group algebras and character theory. We will continue with the representations of compact topological groups and some classical Lie groups (e.g., the 2 x 2 invertible matrices). We will discuss the theory behind the finite dimensional representation of Lie groups: Cartan sub-algebras, root systems, highest weight representations, the Weyl character formula.<br><br>It will be assumed that the student has a good foundation in linear algebra. Familiarity with the basics of topology and measure theory is needed for the second part of the course.<br><br>View additional information :<br>http://www.math.uh.edu/%7etorok/math_6397_Groups/ |

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Math 6397 Stochastic Process (Section#34507 )

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|---|---|
| Time: | TuTh 11:30AM - 1:00PM - Room: AH 301 |
| Instructor: | E. Kao |
| Prerequisites: | Math 6382 |
| Text(s): | Required Texts:<br>1. Adventures in Stochastic processes, by Sidney I. Resnick, Birkhauser, 1992.<br><br>2. An Introduction to Stochastic Processes, by Edward P. C. Kao, Duxbury Press, 1998. |

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| Description: | The course is an introduction to stochastic processes. In this course, we will cover renewal processes, Poisson processes, discrete time Markov chains, continuous-time Markov chains, point processes, and diffusion processes. We will deal with theoreticaldevelopment, modeling, computation, and real-world applications. Students are expected to use computers to do problem solving from time to time (e.g., via R and/or MATLAB). |

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Math 6397 Numerical Methods for Option Pricing in Finance (Section#34508 )

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|---|---|
| Time: | MoWe 1:00PM - 2:30PM - Room: SEC 203 |
| Instructor: | R. Hoppe |
| Prerequisites: | Calculus, Linear Algebra, Basic linebreak Knowledge in Probability Theory and Stochastics |
| Text(s): | Recommended Texts:<br>- R. Seydel; Tools for Computational Finance. 2nd Edition. Springer, Berlin-Heidelberg-New York, 2004<br>- Y. Achdou, O. Pironneau; Computational Methods for Option Pricing. SIAM, Philadelphia, 2005. |
| Description: | The course gives a brief overviewon the foundations of financial markets and financial derivatives and then focuses on the following topics:<br>- Binomial methods and the discrete Black-Scholes formula,}<br>- The Black-Scholes equation and its numerical evaluation,}<br>- Monte-Carlo methods and numerical solution of stochasticdifferential equations,<br>- Pricing of European options, numerical solution of parabolic PDEs,}<br>- Pricing of American options, numerical solution of free boundaryproblems,<br>- Pricing of exotic options. |

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Math 7321 Functional Analysis (Section#34509 )

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| Time: | MoWeFr 10:00AM - 11:00AM - Room: contact Prof. David Blecher |
| Instructor: | D. Blecher |
| Prerequisites: | Some basic knowledge of Banach spaces, and Hilbert spaces |
| Text(s): | None required (Notes will be provided)<br>Recommended Texts:<br>- Conway's "A course in Functional Analysis" and "A course in operator theory" |
| Description: | As long as students know some basics about Banach and Hilbert spaces, they are encouraged to sign up even if they did not take the first semester. The course material is fairly disjoint.<br><br>I. Operator theory on Hilbert and Banach spaces<br>We will try make this as disjoint as possible from the "Operator Theory" course last Spring.<br><br>II. Algebras and spectral theory.<br>Commutative Banach algebras and the Gelfand transform. The characterization of commutative C*-algebras and the functional calculus for normal operators. The spectral theorem for normal operators. The Fourier transform for locally compact groups.<br><br>III. Von Neumann algebras.<br><br>IV. Unbounded operators.<br><br>V. Students requests. |

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Math 7350 Geometry of Manifolds (Section#13406 )

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| Time: | MoWe 4:00PM - 5:30PM - Room: SEC 201 |
| Instructor: | W. Ott |
| Prerequisites: | Math 6342 or consent of the instructor |
| Text(s): | Introduction to Smooth Manifolds by John M. Lee |
| Description: | This is the second part of the two-semester topology/geometry sequence. The core material includes smooth manifolds, smooth maps, tangent vectors, cotangent vectors, vector fields, and vector bundles. After we cover the core material, we will study a subset of the following topics: embedding theory, introduction to Lie groups and Lie algebras, tensors, differential forms, integration on manifolds, de Rham cohomology, flows, and foliations. |