Department of Mathematics

Fall 2012

I. GRADUATE COURSE CATALOG

II. GRADUATE COURSE Fall 2012 (08/27/2012 - 12/20/2012)

SENIOR UNDERGRADUATE COURSES

Math 4310 - Section# 19752 - Biostatistics - by C. Peters
Math 4320 - Section# 15920 - Introduction to Stochastic Processes - by K. Josic
Math 4331 - Section# 16903 - Introduction to Real Analysis - by D. Wagner
Math 4335 - Section# 19753 - Partial Differential Equations (Online course)- by J. Morgan
Math 4350 - Section# 21435 - Differential Geometry - by M. Ru
Math 4364 - Section# 15921 - Numerical Analysis - by J. Qiu
Math 4377 - Section# 16902 - Advanced Linear Algebra I - by G. Heier
Math 4377* - Section# 18614 - Advanced Linear Algebra I - by A. Torok
Math 4388 - Section# 20174 - History of mathematics (online) - by S. Ji
Math 4389 - Section# 17853 - Survey of Undergraduate Mathematics (Online)- by C. Peters

GRADUATE ONLINE COURSES

Math 5331 - Section# 18616 - Linear algebra with applications - by K. Kaiser
Math 5333 - Section# 21437 - Analysis - by G. Egten
Math 5350 - Section# 21438 - Differential geometry - by M. Ru
Math 5385 - Section# 16906 - Statistics - by C. Peteres
Math 5397 - Section# 21439 - Partial Differential Equations - by J. Morgan

GRADUATE COURSES

Math 6302 - Section# 15934 - Modern Algebra (K. Kaiser)
Math 6304 - Section# 21440 - Theory of Matrices (B. Bodmann)
Math 6308 - Section# 16904 - Advanced Linear Algebra I (G. Heier)
Math 6308* - Section# 18615 - Advanced Linear Algebra I (A. Torok)
Math 6312 - Section# 16905 - Introduction to Real Analysis (D. Wagner)
Math 6320 - Section# 15967 - Theory of Functions of a Real Variable (D. Labate)
Math 6324 - Section# 21441 - Differential Equations (V. Climenhaga)
Math 6342 - Section# 15968 - Topology (W. Ott)
Math 6360* - Section# 16877 - Applicable Analysis (Y. Gorb)
Math 6366 - Section# 15969 - Optimization and Variational Methods (G. Auchmuty)
Math 6370* - Section# 15970 - Numerical Analysis (J. He)
Math 6382 - Section# 15971 - Probability Models and Mathematical Statistics (R. Azencott)
Math 6384 - Section# 15972 - Discrete -Time Models in Finance (E. Kao)

Math 6397* - Section# 33078 - Applied inverse problems (D. Onofrei)
Math 6397** - Section# 33077 - Mathematical introduction to fluid mechanics (M. Perepelitsa)
Math 6397 - Section# 21442 - Statistical Computing (E. Kao)
Math 6397 - Section# 37282 - Complex analysis & geometry (S. Ji)
Math 7397 - Section# 21443 - Finite Element Methods (R. Hoppe)
Math 7320 - Section# 21444 - Functional analysis (D. Blecher)

*** : This course also has an online version.**
**** : By mistake, this course's title is listed incorrectly in MyUH website: "Intro to Math Fluid Dynamics". This correct course title is "Mathematical introduction to fluid mechanics"**

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 4310 Biostatistics (Section# 19752)

Time: MoWeFr 12:00PM - 1:00PM - Room: SEC 203
Instructor: C. Peters
Prerequisites:
Text(s):
Description:

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Math 4320 Introduction to Stochastic Processes (Section# 15920)

Time: MoWeFr 10:00AM - 11:00AM - Room: PGH 345
Instructor: K. Josic
Prerequisites: Math 3338

Text(s):	"An Introduction to Stochastic Modeling" by Mark Pinsky, Samuel Karlin. Academic Press, Fourth Edition. ISBN-10: 9780123814166 ISBN-13: 978-0123814166
Description:	We study the theory and applications of stochastic processes. Topics include discrete Markov chains, Poisson process, renewal phenomena, introduction to Brownian motion and stochastic calculus, and queueing theory.

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Math 4331 Introduction to Real Analysis (Section# 16903)

Time:	MoWeFr 11:00AM - 12:00PM - Room: SR 117
Instructor:	D. Wagner
Prerequisites:	Math 3333 and 3334.
Text(s):	"Principles of Mathematical Analysis" Third Edition, by Walter Rudin, McGraw-Hill, Inc.
Description:	This course covers the theoretical underpinnings of real analysis. It is intended for students planning to go on to graduate school in mathematics. Stress will be placed on students proving theorems correctly. Homework will be collected weekly and graded. As time permits, we will provide examples giving application of the theory to problems in analysis. Topics: Math 4331 1. The Real and Complex Number Systems 2. Basic Topology, Metric Spaces 3. Numerical Sequences and Series 4. Continuous Functions 5. Derivatives Note that topics 3-5 will be covered in considerably more depth than one encounters in a Calculus course. Math 4332 (next semester) 1. The Riemann-Stieltjes Integral 2. Sequences and Series of Functions 3a. Exponential and Trigonometric functions 3b. Fourier Series 3c. The Gamma Function 4. Functions of Several Variables: 4a. Linear Transformations 4b. Derivatives 4c. The Contraction Mapping Theorem 4d. The Inverse Function and Implicit Function theorems 4e. Differentiation of Integrals 5. The Lebesgue Theory of Integration The location of the boundary between 4331 and 4332 is somewhat uncertain.

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Math 4335 Partial Differential Equations (Section# 19753)

Time:	Arrange (online course)
Instructor:	J. Morgan
Prerequisites:	Calculus III and undergraduate differential equations. For example, Math 2433 and either Math 3321 or 3331.
Text(s):	Partial Differential Equations, An Introduction, by Walter A. Strauss.

The material for the course is a subset of the material listed in the text above. More specifically, we will cover the sections below.

Description:

Chapter 1: Where PDEs come from

1.1 What is a Partial Differential Equation?
1.2 First-Order Linear Equations
1.3 Flows, Vibrations, and Diffusions
1.4 Initial and Boundary Conditions
1.5 Well-Posed Problems

Chapter 2: Waves and Diffusions

2.1 The Wave Equation
2.2 Causality and Energy
2.3 The Diffusion Equation
2.4 Diffusion on the Whole Line
2.5 Comparison of Waves and Diffusions

Chapter 4: Boundary Problems

4.1 Separation of Variables, the Dirichlet Condition
4.2 The Neumann Condition
4.3 The Robin Condition

Chapter 5: Fourier Series

5.1 The Coefficients
5.2 Even, Odd, Periodic, and Complex Functions
5.3 Orthogonality and General Fourier Series
5.4 Completeness

Chapter 6: Harmonic Functions

6.1 Laplace's Equation
6.2 Rectangles and Cubes
6.3 Poisson's Formula

Regular homework will be given, along with a midterm exam and a final exam.
There will be an online live lecture each week on Thursdays from 4-6pm. This lecture will be recorded and available on the course homepage.

Grades: 30% midterm exam, 40% final exam, 30% homework.

A link to the course homepage will appear at http://www.math.uh.edu/~jmorgan prior to the beginning of the fall 2012 semester.

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Math 4350 Differential Geometry (Section# 21435)

Time:	MoWe 1:00PM - 2:30PM - Room: AH 301
Instructor:	M.Ru
Prerequisites:	Math 2433 Calculus of Functions of Several Variables Math 2431 Linear Algebra

	Lecture notes
Text(s):	reference text: an online book of 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 year-long course will introduce the theory of the geometry of curves and surfaces in three-dimensional space using calculus techniques, exhibiting the interplay between local and global quantities. Topics include: curves in the plane and in space, global properties of curves and surfaces in three dimensions, the first fundamental form, curvature of surfaces, Gaussian curvature and the Gaussian map, geodesics, minimal surfaces, Gauss' Theorem Egregium, Gauss-Bonnet theorem etc.

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Math 4364 Numerical Analysis (Section# 15921)

Time:	TuTh 4:00PM - 5:30PM - Room: PGH 345
Instructor:	J Qiu
Prerequisites:	Calculus, linear algebra, differential equations, and experience of computer programming
Text(s):	R. Burden and J. Faires, Numerical Analysis, 8th edition, Thomson, 2005
Description:	Introduce basic concepts in scientific computing; explain how, why and when numerical methods are expected to work; provide a firm basis for future studies in scientific computing; provide simulation tools for scientific and engineering problems.

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Math 4377 Advanced Linear Algebra I (Section# 16902)

Time:	MoWe 4:00PM - 5:30PM - Room: F 154
Instructor:	G. Heier
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.

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Math 4377 Advanced Linear Algebra I (Section# 18614)

Time:	TuTh 10:00AM - 11:30AM - Room: F 154
Instructor:	A. Torok
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:	This course meeting is online or in classroom

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Math 4388 History of Mathematics (Section# 20174)

Time:	Online course
Instructor:	S. Ji
Prerequisites:	Math 3333 Intermediate Analysis, or content of instructor
Text(s):	Text Lecture notes provided. No textbook is required. Reference: Victor Katz, A History of Mathematics: An Introduction, 3rd (or 2nd Ed.), Addison-Wesley, 2009 (or 1998).

Description This course is designed to provide a college-level experience in history of mathematics. Students will understand some critical historical mathematics events, such as creation of classical Greek mathematics, and development of calculus; recognize notable mathematicians and the impact of their discoveries, such as Fermat, Descartes, Newton and Leibniz, Euler and Gauss; understand the development of certain mathematical topics, such as Pythagoras theorem, the real number theory and calculus.

Aims of the course: To help students
- to understand the history of mathematics;
- to attain an orientation in the history and philosophy of mathematics;
- to gain an appreciation for our ancestor's effort and great contribution;
- to gain an appreciation for the current state of mathematics;
- to obtain inspiration for mathematical education,
- and to obtain inspiration for further development of mathematics.

Description: On-line course is taught through Blackboard Vista, visit http://www.uh.edu/webct/ for information on obtaining ID and password.

The course will be based on my notes.

In each week, three chapters of my notes will be posted in Blackboard Vista. Weekly homework and reading assignment will be posted in Blackboard Vista, including projects(essays).

In each week, turn all your homework once by Sunday midnight through Blackboard Vista.

All homework, essays or exam paper, handwriting or typed, should be turned into PDF files and be submitted through Blackboard Vista.

There is one open-notes final exam in form of multiple choice.

Grading: 30% homework, 50% projects, 20 % Final exam.

By petition, this course will be counted toward major or minor requirements in mathematics.

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Math 4389 Survey of Undergraduate Mathematics (Section# 17853)

Time: Online course
Instructor: C. Peters
Prerequisites:
Text(s):
Description:

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GRADUATE ONLINE COURSES

Math 5331 Linear algebra with applications (Section# 18616)

Time: Arrange (online course)
Instructor: K. Kaiser
Prerequisites:

Text(s):
Description:

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Math 5333 Analysis (Section# 21437)

Time: Arrange (online course)
Instructor: G. Egten
Prerequisites:
Text(s):
Description:

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Math 5350 Differential geometry (Section# 21438)

Time: Arrange (online course)
Instructor: M. Ru
Prerequisites: Math 2433(or equivalent) or consent of instructor.
Text(s): A set of notes on curves and surfaces will be written and distributed by Dr. Ru.
Description: The course will be an introduction to the study of Differential Geometry-one of the classical (and also one of the more appealing) subjects of modern mathematics. We will primarily concerned with curves in the plane and in 3-space, and with surfaces in 3-space. We will use multi-variable calculus, linear algebra, and ordinary differential equations to study the geometry of curves and surfaces in R3. Topics include: Curves in the plane and in 3-space, curvature, Frenet frame, surfaces in 3-space, the first and second fundamental form, curvatures of surfaces, Gauss's theorem egrigium, Gauss-Bonnet theorem, minimal surfaces.

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Math 5385 Statistics (Section# 16906)

Time: Arrange (online course)
Instructor: C. Peters
Prerequisites:
Text(s):
Description:

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Math 5397 Partial Differential Equations (Section# 21439)

Time: Arrange (online course)
Instructor: J. Morgan
Prerequisites: Calculus III and undergraduate differential equations. For example, Math 2433 and either Math 3321 or 3331.
Text(s): Partial Differential Equations, An Introduction, by Walter A. Strauss.

Description:

The material for the course is a subset of the material listed in the text above. More specifically, we will cover the sections below.

Chapter 1: Where PDEs come from

1.1 What is a Partial Differential Equation?
1.2 First-Order Linear Equations
1.3 Flows, Vibrations, and Diffusions
1.4 Initial and Boundary Conditions
1.5 Well-Posed Problems

Chapter 2: Waves and Diffusions

2.1 The Wave Equation
2.2 Causality and Energy
2.3 The Diffusion Equation
2.4 Diffusion on the Whole Line
2.5 Comparison of Waves and Diffusions

Chapter 4: Boundary Problems

4.1 Separation of Variables, the Dirichlet Condition
4.2 The Neumann Condition
4.3 The Robin Condition

Chapter 5: Fourier Series

5.1 The Coefficients
5.2 Even, Odd, Periodic, and Complex Functions
5.3 Orthogonality and General Fourier Series
5.4 Completeness

Chapter 6: Harmonic Functions

6.1 Laplace's Equation
6.2 Rectangles and Cubes
6.3 Poisson's Formula

Regular homework will be given, along with a midterm exam and a final exam.
There will be an online live lecture each week on Thursdays from 4-6pm. This lecture will be recorded and available on the course homepage.

Grades: 30% midterm exam, 40% final exam, 30% homework.

A link to the course homepage will appear at http://www.math.uh.edu/~jmorgan prior to the beginning of the fall 2012 semester.

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GRADUATE COURSES

Math 6302 Modern Algebra (Section# 15934)

Time:	TuTh 11:30AM - 1:00PM - Room: PGH 350
Instructor:	K. Kaiser
Prerequisites:	
Text(s):	
Description:	

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Math 6304 Theory of Matrices (Section# 21440)

Time:	TuTh 11:30AM - 1:00PM - Room: PGH 345
Instructor:	B. Bodmann
Prerequisites:	Math 4377 and 4331 or Math 6377
Text(s):	Matrix Analysis, by Roger A. Horn and Charles R. Johnson, Cambridge University Press, 1985, ISBN 978-0-521-38632-6
Description:	We will cover topics in linear algebra and matrix theory that have proven to be important in analysis and applied mathematics. We assume that the student is familiar with standard concepts and results from linear algebra and basic analysis. We will study canonical factorizations of matrices, including the QR, triangular and Cholesky factorizations. We will develop ways to achieve the Jordan canonical form. We will study eigenvalue perturbation and estimation results and we will study special families of matrices such as positive definite, Hermitian, Hankel, and Toeplitz matrices. Matrix analysis relies on concepts from analysis, such as limits, continuity and power series, to get results in linear algebra.

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Math 6308 Advanced Linear Algebra I (Section# 16904)

Time:	MoWe 4:00PM - 5:30PM - Room: F 154
Instructor:	G. Heier
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.

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Math 6308 Advanced Linear Algebra I (Section# 18615)

Time:	TuTh 10:00AM - 11:30AM - Room: F 154
Instructor:	A. Torok
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. This course meeting is online or in classroom.
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 6312 Introduction to Real Analysis (Section# 16905)

Time:	MoWeFr 11:00AM - 12:00PM - Room: SR 117
Instructor:	D. Wagner
Prerequisites:	Math 3333 and 3334.
Text(s):	"Principles of Mathematical Analysis" Third Edition, by Walter Rudin, McGraw-Hill, Inc.
Description:	This course covers the theoretical underpinnings of real analysis. It is intended for students planning to go on to graduate school in mathematics. Stress will be placed on students proving theorems correctly. Homework will be collected weekly and graded. As time permits, we will provide examples giving application of the theory to problems in analysis. Topics: Math 4331 1. The Real and Complex Number Systems 2. Basic Topology, Metric Spaces 3. Numerical Sequences and Series 4. Continuous Functions 5. Derivatives Note that topics 3-5 will be covered in considerably more depth than one encounters in a Calculus course. Math 4332 (next semester) 1. The Riemann-Stieltjes Integral 2. Sequences and Series of Functions 3a. Exponential and Trigonometric functions 3b. Fourier Series 3c. The Gamma Function 4. Functions of Several Variables: 4a. Linear Transformations 4b. Derivatives 4c. The Contraction Mapping Theorem 4d. The Inverse Function and Implicit Function theorems 4e. Differentiation of Integrals 5. The Lebesgue Theory of Integration The location of the boundary between 4331 and 4332 is somewhat uncertain.
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 6320 Theory of Functions of a Real Variable (Section# 15967)

Time:	MoWeFr 11:00AM - 12:00PM - Room: PGH 345
Instructor:	D. Labate
Prerequisites:	An undergraduate real analysis sequence (Math 4331, 4332) or equivalent. A basic knowledge of topology and metric spaces is useful.
Text(s):	Lebesgue Integration on Euclidean Space (Revised Ed.). Publisher: Jones and Bartlett Books in Mathematics. Author: Frank Jones. Publication Date: November 8, 2000 ISBN-10: 0763717088 | ISBN-13: 978-0763717087
Description:	This is the first semester of a 2 semester sequence. The first semester focuses on the basic principles of measure and integration, which is essential in many areas of mathematics including analysis and probability. This semester will be devoted mostly to the following topics: Measures. Measurable functions. Lebesgue integration. Convergence of sequences of functions. Lp spaces.

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Math 6324 Differential Equations (Section# 21441)

Time: TuTh 11:30AM - 1:00PM - Room: SEC 202
Instructor: V. Climenhaga
Prerequisites:
Text(s):
Lecture note.

Recommended Texts:
- Differential Equations, Dynamical Systems and Linear Algebra by M. Hirsch and S. Smale (available at Amazon or in the library)
- Ordinary Differential Equations by V. I. Arnold, M.I.T press, 1998 (paperback).
- Geometrical Methods in the Theory of Ordinary Differential Equations by V. I. Arnold, Springer Verlag, 2nd Edition 1988.
- Nonlinear Oscillations, Dynamical Systems and Bifurcations of Vector Fields by J. Guckenheimer and P. Holmes (Applied Mathematical Sciences Vol 42) Springer Verlag.
- Mathematical Methods of Classical Mechanics by V. I. Arnold, Springer Verlag, 2nd Edition.

Description:
This course is an introduction to differential equations. We cover linear theory: existence and uniqueness for autonomous and non-autonomous equations; stability analysis; stable and unstable manifolds; floquet theory and elementary bifurcation theory. We will also cover topics such as quasiperiodic motion; normal form theory; perturbation theory and classical mechanics.

Assessment:
There will be one midterm (worth 20 points), a final exam (30 points) as well as 2 to 4 take-home problem sheets (to make up 50 points in total).

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Math 6342 Topology (Section# 15968)

Time: MoWeFr 12:00PM - 1:00PM - Room: PGH 348
Instructor: W. Ott
Prerequisites:
Text(s):
Description:

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Math 6360 Applicable Analysis (part I) (Section# 16877)

Time: TuTh 11:30AM - 1:00PM - Room: F 154
Instructor: Y. Gorb
Prerequisites: MATH 4331 or equivalent or consent of instructor.
Text(s): John Hunter, Bruno Nachtergaele, Applied Analysis, World Scientific Publishing Company, 2005.

Description:
This course meeting is online or in classroom.

This course treats topics related to the solvability of various types of equations, and also of optimization and variational problems. The first half of the semester will concentrate on introductory material about norms, Banach and Hilbert spaces, etc. This will be used to obtain conditions for the solvability of linear equations, including the Fredholm alternative. The main focus will be on the theory for equations that typically arise in applications. In the second half of the course the contraction mapping theorem and its applications will be discussed. Also, topics to be covered include finite dimensional implicit and inverse function theorems, and existence of solutions of initial value problems for ordinary differential equations and integral equations.

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Math 6366 Optimization and Variational Methods (Section# 15969)

Time:	TuTh 4:00PM - 5:30PM - Room: PGH 347
Instructor:	G. Auchmuty
Prerequisites:	Math 4331-2 and Math 4377-8 or equivalent.
Text(s):	There is no required text for the course. Some notes for the course will be available from the instructor. Reference books are: - L.D. Berkowitz, Convexity and Optimization in Rn, Wiley Interscience 2002 - Stephen Boyd and L. Vanderberghe, Convex Optimization, Cambridge U. Press.
Description:	This course will cover topics in finite dimensional optimization theory emphasizing algorithms for finding minimizers and the conditions that hold at minima. The first topics will be descriptions of steepest descent and conjugate gradient algorithms for unconstrained minimization. Then various topics involving convex constrained optimization including Lagrangian and penalty methods methods will betreated.

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Math 6370 Numerical Analysis (Section# 15970)

Time:	TuTh 1:00PM - 2:30PM - Room: SEC 201
Instructor:	J. He
Prerequisites:	
Text(s):	
Description:	
Remark:	This course meeting is online or in classroom

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Math 6382 Probability Models and Mathematical Statistics (Section# 15971)

Time:	TuTh 2:30PM - 4:00PM - Room: PGH 348
Instructor:	R. Azencott
Prerequisites:	Undergraduate course in probability
Text(s):	Reference Books Allan Gut: "An intermediate course in probability" Publisher :Springer Jeffrey Rosenthal: "A first look at rigorous probability" Publisher: World Scientific Publishing Company

Description:	The main goals are to reach a good mathematical understanding of key probability concepts, and to develop competence in problem solving, as well as familiarity with fairly basic numerical simulations of random processes . Course contents : - random variables and probability spaces, - major discrete and continuous distributions, - joint distributions and conditional probability, - joint and marginal density functions, - characteristic functions, - independent random variables, - Markov chains on finite state spaces, stationary distributions, first hitting times, - modes of convergence, central limit theorem , law of large numbers. The course will be illustrated through examples and applications. Note: Some of the homework assignments will involve numerical simulations (to be implemented in Matlab or similar scientific softwares) Exams : Midterm (1.5hours) Final (3 hours) Final grade based on weighted average of Homework, Midterm, Final

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Math 6384 Discrete -Time Models in Finance (Section# 15972)

Time:	TuTh 4:00PM - 5:30PM - Room: 301 AH
Instructor:	E. Kao
Prerequisites:	Concurrent registration of MATH 6382, or some prior background in elementary probability.
Text(s):	Introduction to Mathematical Finance: Discrete Time Models, by Stanley R. Pliska, Blackwell, 1997.
Description:	The course is an introduction to discrete-time models in finance. We start with single-period securities markets and discuss arbitrage, risk-neutral probabilities, complete and incomplete markets. We survey consumption investment problems, mean-variance portfolio analysis, and equilibrium models. These ideas are then explored in multiperiod settings. Valuation of options, futures, and other derivatives on equities, currencies, commodities, and fixed-income securities will be covered under discrete-time paradigms.

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Math 6397 Applied inverse problems (Section# 33078)

Time:	MoWeFr 10:00AM - 11:00AM - Room: PGH 348
Instructor:	D. Onofrei
Prerequisites:	The ideal prerequisites are MA5332 or MA6324-MA6325, MA5350 and MA6374 or MA6377 but the course will be so designed that any interested student with some background in linear algebra and partial differential equations will benefit from it.
Text(s):	Lecture notes

This course meeting is online or in classroom.

Description:

The most natural question for a student before joining this class usually is: What is an inverse problem? It is the aim of this class to introduce the students to the mathematical and physical principles behind various inverse problems and to discuss how they can be used to understand questions from medical imaging, radar imaging, cloaking and invisibility, oil explorations and recovery, shape optimization or recovering the inner structure of the earth.

A very non-rigorous definition of an inverse problem is that, in a sense, an inverse problem is the “dual” to a direct problem associated to the same model. The simplest example of such dual pair, i.e., direct/inverse problems, is associated to a linear system: here the direct problem will be, for a given mxn matrix A and a given nx1 vector v determine the product Av while the inverse problem will be, for known Av, determine v. So every time you solved a linear system you solved in fact an inverse problem.

For medical imaging, the practical question will be to detect cancerous tumors, or other abnormalities present in a part of the human body by non-invasive methods, i.e., by using only data collected without direct contact with the patient. Thus, from the acquired data the scientist would like to invert and obtain information about the source of this data. The same scenario is valid for the problem of mapping the inner structure of the earth or the problem of oil exploration and recovery problems, where the engineer would like to be able to map the inner structure of the earth (thus detecting potential oil resources and their size) only from inexpensive data acquired at the surface of the earth. For the shape optimization problem the practical question may be, for example, to find the shape that globally minimizes cost and weight, still giving optimal performance.

The cloaking question is, as the name suggests, related to the desire of making certain targets invisible to radar or sonar. A possible inverse problem approach to this question will inquire into the possibility to design suitable antennas to achieve the desired nulling around the object of interest while maintaining its communication capability.

Remark: This course meeting is online or in classroom

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Math 6397 Mathematical introduction to fluid mechanics (Section# 33077)

Time: MoWe 4:00PM - 5:30PM - Room: PGH 350

Instructor: M. Perepelitsa

Prerequisites: Graduate standing. MATH 3331 (ODEs) and MATH 4335 (ODEs, or at least MATH 3363 PDE) are required. Students should also be familiar with the material of MATH 4331 (or 6312).

Text(s): An Introduction to Theoretical Fluid Mechanics, by StephenChildress ISBN-10: 0-8218-4888-7

Description: The course will start with the introduction of the classical continuum model for the motion of uids based on the conservatioin of mascroscopic physical quantatites. We discuss the kinematics of a ow eld and the main quantaties involved in the the description of the uid motions, such as the vorticity and the rate of deformation tensor. Following that we consider dynamical properites of various types of ideal inviscid and viscous ows, as well as the boundary layer theory. The models for motion of compressible uids (gases) are considered in the last part of the course. The main focus there on the nonlinear waves (shock and rarefaction waves) for the compressible Euler equations in one-dimension.

Course Syllabus:

1. The Fluid Continuum
1.1. Eulerian and Lagrangian Descriptions
1.2. The Material Derivative

2. Conservation of Mass and Momentum
2.1. Conservation of Mass
2.2. Conservation of Momentum in an Ideal Fluid
2.3. Steady Flow of a Fluid of Constant Density
2.4. Intrinsic Coordinates in Steady Flow
2.5. Potential Flows with Constant Density
2.6. Boundary Conditions on an Ideal Fluid

3. Vorticity
3.1. Local Analysis of the Velocity Field
3.2. Circulation
3.3. Kelvins Theorem for a Barotropic Fluid
3.4. The Vorticity Equation
3.5. Helmholtz Laws
3.6. The Velocity Field Created by a Given Vorticity Field
3.7. Some Examples of Vortical Flows

4. Potential Flow
4.1. Harmonic Flows
4.2. Flows in Three Dimensions
4.3. Apparent Mass and the Dynamics of a Body in a Fluid
4.4. Deformable Bodies and Their Locomotion
4.5. Drift

5. Viscosity and the Navier-Stokes Equations
5.1. The Newtonian Stress Tensor
5.2. Some Examples of Incompressible Viscous Flow
5.3. Dynamical Similarity

6. Stokes Flow
6.1. Solutions of the Stokes Equations
6.2. Uniqueness of Stokes Flows
6.3. The Stokes Solution for Uniform Flow Past a Sphere
6.4. Two Dimensions: Stokes Paradox
6.5. Time Reversibility in Stokes Flow

7. The Boundary Layer
7.1. The Limit of Large Re
7.2. Blasius Solution for a Semi-Innite Flat Plate

	7.3. Boundary Layer Analysis as a Matching Problem 7.4. Separation 7.5. Prandtl-Batchelor Theory 8. Energy 8.1. Mechanical Energy 8.2. Elements of Classical Thermodynamics 8.3. The Energy Equation
Remark:	by a mistake, this course is listed in PeopleSoft by a wrong title: "Intro to Math Fluid Dynamics". This course title is "Mathematical introduction to fluid mechanics"

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Math 6397 Statistical Computing (Section# 21442)

Time:	TuTh 10:00AM - 11:30AM - Room: D3 E323 (the room was changed from SR 516 to D3 E323)
Instructor:	E. Kao
Prerequisites:	MATH 6382 and 6383.
Text(s):	Monte Carlo Statistical methods, Springer, New York, by Christian P. Robert and George Casella, 2004.
Description:	The course is an introduction to computational statistics. The subjects include random number generation, Monte Carlo integration, the metropolis-Hasting algorithm, the Gibbs samplers, missing data models, monitoring of convergence, nonparametric methods, Bayesian data analysis. Students are expected to develop computer programming skills in R for performing statistical analyses.

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Math 6397 Complex Analysis & Geometry (Section# 37282)

Time:	Online Course
Instructor:	S. Ji
Prerequisites:	Math 6322-6323, or equivalent.
Text(s):	Lecture Note (No required textbook)
Description:	L^2 Estimates, Coherent Sheaves, Complex Analytic Spaces, Positive Currents and Potential Theory, Sheaf Cohomology, Positive Vector Bundles and Vanishing Theorems.

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Math 7397 Finite Element Methods (Section# 21443)

Time:	MoWe 1:00PM - 2:30PM - Room: SEC 203
Instructor:	R. Hoppe
Prerequisites:	Calculus, Linear Algebra, Numerical Analysis
Text(s):	reference books: D. Braess; Finite Elements. Theory, Fast Solvers and Applications in Solid Mechanics. 3rd Edition. Cambridge Univ. Press, Cambridge, 2007 S.C. Brenner and L. Ridgway Scott; The Mathematical Theory of Finite Element Methods. 3rd Edition. Springer, New York, 2008
Description:	Finite Element Methods are widely used discretization techniques for the numerical solution of PDEs based on appropriate variational formulations. We begin with basic principles for the construction of Conforming Finite Elements and Finite Element Spaces with respect to triangulations of the computational domain. Then, we study in detail a priori estimates for the global discretization error in various norms of the underlying function space. Nonconforming and Mixed Finite Element Methods will be addressed as well. A further important issue is adaptive grid refinement on the basis of efficient and reliable a posteriori error estimators for the global discretization error.

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Math 7320 Functional analysis (Section# 21444)

Time:	MoWeFr 10:00AM - 11:00AM - Room: PGH 350
Instructor:	D. Blecher
Prerequisites:	
Text(s):	Lecture notes will be provided. Recommended book: Pedersen's "Analysis Now" or Conway's "A course in Functional Analysis".
Description:	Although we will be starting from scratch, if you wish to do some preliminary reading you could read the middle section in Royden's book on Real Analysis (on the Hahn Banach theorem, and so on). We will be starting with a little topology - so you might glance through any good basic book on topology to familiarize yourself with "compactness" , "locally compact", continuous functions between topological spaces, the basic theory of metric spaces. The reason I review some topology is to familiarize the students with the use of `nets' (=generalized sequences). We will mostly avoid measure theory, so don't be too concerned if you lack that background. The tests and exam will be based on the notes given in class, and on the homework. After each chapter we will schedule a problem solving workshop, based on the homework assigned for that chapter. Final grade is approximately based on a total score of 400 points consisting of homework (100 points), a semester test (100 points), and a final exam (200 points). The instructor may change this at his discretion. This semester will be a leisurely and general presentation, starting from scratch, of the basic facts in Linear Analysis, Banach spaces, weak topologies, and a little spectral theory.