

ANNUAL REPORT

2004

Annual Report
Mathematics Department
2004

Department Head's Summary

- Research and Scholarship
 - 2 early career awards ending in 2005: CAREER (Gwen Lloyd) and PECASE (Jeff Borggaard)
 - Terry Herdman as university director of research computing, has kept the math department fully involved in the teraflop computer project.
 - We hired four postdocs for 2004-2005. A postdoc from Germany supported on German funds also joined the department. This coincides with our plan to keep up the increased presence of postdocs in the department. All of the postdocs will be serving a second year in 2005-2006,
 - Faculty has published over 100 articles in refereed journals and given over 150 invited lectures.
 - Faculty has over 40 active grants including a 2.3M grant awarded to our ICAM team from DARPA.
 - Faculty has over 35 Editorships or Associate Editorships of peer reviewed journals.
 - Active colloquium series, 25 outside speakers brought in each year.
 - Interdisciplinary Research with AOE, CS, VBI, ChemE, Biology, EE, ME
 - Together with VBI and Statistics, we reapplied for an NSF IGERT grant.
 - Over the last two years, a strong computational group in the Math Department consisting of Beattie and Borggaard and joined by new comers Iliescu and Gugercin has applied for 3 grants. (Two grants have been awarded in 2005.) With the addition of Jennifer Ryan and Lizette Zietsman next year, this group has much potential.
 - With the blessing of Dean Chang, the math department has lowered the teaching loads of research active faculty to 2-1. Faculty need to apply each year and must either have grant support or have applied for support in the past year. This should serve as motivation to continue to apply for grants and make us more competitive in the market place.
 - We were a part of the College's computational cluster in 2004-2005. We will hire Lizette Zietsman and James Turner in 2005 as a result of that initiative.

- Graduate Program

- There were 76 graduate students in residence in 2004. 52 are GTA supported and 10 have outside support.
 - US News ranks our graduate program in Applied Mathematics 33rd in the country.
 - In 2004 we conferred 16 M.S. degrees and 9 Ph.D. degrees
 - To counter the lack of available American Ph.D. students, we have begun to aggressively recruit foreign Ph.D. level students. Consequently we have increasing the ratio of Ph.D. to MS students in our program. We have established new connections to Russia, Tunisia and Peru. Nine students from these countries began in Fall 2004
 - The number of graduate student applications was up. The number of new students on support in 2004 was 18, 7 more than in 2003. The 2005 projection is 17.
 - John Rossi and Geoff Vining, Head of Statistics went on a recruiting trip to San Marcos University in Lima, Peru. There are now 3 Ph.D. students from San Marcos in our program. We expect there to be 2 more in 2006.
- **Undergraduate Program**
 - 13 students completed Undergraduate Research projects in 2004, 2 more than last year and more than double the total in 2002. We hope to bring this number up to 20 in the next two years.
 - B.S. degrees were conferred on 76 students. Our average number of mathematics majors is consistently over 65. This puts us in the top 16 in the country.
 - Our Math Ed option continues to graduate on average 20 students licensed to teach in the Commonwealth.
 - Our Math 1015, 1016 classes, servicing almost 2000 students each per year, have been completely put on line using an in house product.
 - A test engine allowing asynchronous testing is in place in the Math Emporium. Math 1114, 1015 and 1016 use the system exclusively. Over half a million tests were served at the Math Emporium in 2004.
 - All of our business courses have been moved to larger lecture sections. A team of faculty funded by CEUT successfully automated quiz and homework grading. Business calculus will be completely on line and in the Math Emporium by Fall 2005.
 - Math 1224 has gone to a large lecture/ recitation format with automated homework grading.
 - Use of the Math Emporium has steadily increased. On Tuesdays and Thursdays in Fall 2004, we consistently had about 4000 students check-in.
 - Abbie Kohler was put up for the Alumni Award for Teaching which she subsequently won in 2004.
- **Outreach**

- Ezra Bud Brown was put up for ADP which he subsequently was granted in 2005
- K-12 teacher professional development is run by Wayne Patty. He is in the last year of his large grant.
- We offer online and distance graduate courses for middle/high teachers leading to endorsements or an M.S. degree.
- Sue Hagen is working with the VT STARRS program out of Ed McPherson's office.
- Sue Hagen is working with middle school teachers under a program funded by the Virginia Department of Education and run jointly with VCU, William and Mary, Norfolk State University and Mary Washington College. She teaches one class in the Fall, Spring and Summer in Roanoke County for Roanoke County, Roanoke City and Salem City teachers.
- We sponsor the VT regional Math contest involving 40 colleges/university and 200 students.
- We offered our annual Women's Career Day at the Math Emporium involving 20 regional middle schools, 200 girls and a panel of 5 alumna.
- During Math Awareness Month, we coordinate public talks. We sponsor a poster contest for Montgomery and Giles elementary and middle schoolers. The winner and their parents and teachers are invited to a reception in our Commons Room..
- We resurrected our Advisory Board in Fall 2004.
- As a result of the Pew grant, the department was awarded 5 years ago for course development in the Math Emporium, we were asked to help consult in the new NSF sponsored R2R program run by Carol Twigg. John Rossi and Terri Bourdon are involved in advising over 20 colleges and universities on course transformation.
- Two of our graduate students, Brandi Stigler and Olgamary Rivera-Marrano in conjunction with VBI organized a workshop entitled "Modelling your genes the mathematical way" for teachers and high school students at Tech's Danville Institute.

FACULTY

Hatcher Professor

Burns, John

Professors

Ball, Joseph

Beattie, Christopher

Brown, Ezra

Day, Martin

Farkas, Daniel

Floyd, William

Green, Edward

Greenberg, William

Hagedorn, George

Hannsgen, Kenneth

Haskell, Peter

Herdman, Terry

Holub, James

Johnson, Lee

Kim, Jong Uhn

Klaus, Martin

Kohler, Werner

Laubenbacher, Reinhard

Lin, Tao

Linnell, Peter

McCoy, Robert

Murray, Margaret

Parry, Charles

Patty, C. Wayne

Prather, Carl

Quinn, Frank

Renardy, Michael

Renardy, Yuriko

Riess, R. Dean

Rogers, Robert

Rossi, John

Russell, David

Sachs, Ekkehard

Shaw, Kenneth

Snider, Robert

Sun, Shu Ming

Thomson, James

Wheeler, Robert

Associate Professors

Adjerid, Slimane
Borggaard, Jeffrey
Gao, David
Layman, John
Letzter, Gail
Lloyd, Gwendolyn
Shimozono, Mark
Shockley, James
Washenberger, James
Williams, Michael

Assistant Professors

Iliescu, Traian
Gugercin, Serkan
Wapperom, Peter

Instructors

Agud, Diane
Anderson, Susan
Bonawitz, Elizabeth
Bourdon, Terri
Cothren, Marlene
England, Jerri
Hagen, Susan
Hanks, Lucy
Hart, Heath
Hodges, Charles
Hoggard, John
Holub, Lorraine
Kohler, Abigail
McQuain, Margaret
Powers, Linda
Shealor, Bonnie
Shugart, Eileen
Smith, Deborah
Stephens, Catherine

Visiting Professor

Graham, Bill

Research Associate

Kay, Leslie

Post-Doc/ Research Associate

Kolb, Stefan

Kreiman, Victor
Raney, Mike
Roop, John
Tuba, Imre
Wahl, Charlotte

GRANTS

SLIMANE ADJERID

Adaptive Discontinuous Galerkin Methods for Transient Partial Differential Equations, NSF, Principal investigator, status: current.

ADAPT03 Conference on adaptive methods for partial differential equations, USARO, \$10K, Co-principal investigator, status: Expired in December 2004.

M. Sc. Program in Computational Mechanics at PST and Impacts on Development in Tunisia, State Department, \$187,181, status: current.

SUSAN ANDERSON

Dr. Rossi (PI) and I (Co-PI) submitted a grant proposal for our 2004 “Women in Mathematics: Career Day at Virginia Tech” to the National Security Agency and were awarded \$3,355.00. Career Day is described under IV.B.(i).

JOSEPH BALL

Principal co-investigator (with D. Alpay, C. Sadosky and V. Vinnikov) for Israel-USA Binational Science Foundation Grant “Multidimensional systems, multivariable operator model theory, scattering and function theory”, award dates 09/01/03-08/31/06.

JEFFREY BORGGAARD

Computational Methods for Design, Control and Optimization of Micro Air Vehicles, Senior Investigator (with J. Burns, E. Cliff and T. Iliescu), AFOSR, Grant F49620-02-C-0048 (\$600,000).

Scientific Computing Research Environments in Mathematical Sciences, co-Principal Investigator (with T. Iliescu), NSF, Grant DMS-0322852 (\$155,858).

Control and Optimization Tools for Systems Governed by Nonlinear Partial Differential Equations, Principal Investigator, AFOSR, Grant F49620-00-1-0299 (\$500,000).

JOHN BURNS

“Mathematical and Computational Tools for the Analysis, Design and Optimization of Very Large Membrane Structures with Advanced Material Models” PI (with E.M. Cliff), T.L. Herdman and D.J. Inman), NASA/DARPA Grant (\$2,300.00).

MARTIN DAY

Robust Feedback Control and Analysis of Queuing Systems, NSF Applied Math Program, \$109,980 for 9/1/01 - 8/31/04.

WILLIAM FLOYD

Principal investigator on NSF Grant DMS-427236, 15 July 2002 – 30 June 2005. The total award is \$89,016.

EDWARD GREEN

National Security Agency Research Grant, 2 years, 12/04 – 12/06, 1st year \$29,032, H98230-05-1-0039

Engineering and Physical Sciences Research Council (of England), Visiting Fellowship, \$16,500.

GEORGE HAGEDORN

Principal Investigator for National Science Foundation Grant DMS-0071692, entitled “Mathematical Studies in Quantum Mechanics,” 16 May 2000 – 15 May 2004. Award Amount \$148,500.

Principal Investigator for National Science Foundation Grant DMS-0303586, entitled “Rigorous Studies in Quantum Mechanics,” 16 May 2003 – 15 May 2006. Award Amount \$162,493.00.

SUSAN HAGEN

“Algebra for Highly Qualified Middle School Teachers”, Contract course with Salem City, Roanoke City and Roanoke County School Systems (Summer 2004), Award: \$9982.

“Numbers & Operations for Middle School Teachers”, Contract course with Salem City, Roanoke City and Roanoke County School Systems (Fall 2004) Award: \$5557.

“Preparing Highly Qualified Middle School Mathematics Teachers Across Virginia”, Mathematics & Science Partnership Grant. (2004-5). Partner with James Madison University, Norfolk State University, Mary Washington College and Virginia Commonwealth University. (VA Tech award: \$56,000.

TERRY HERDMAN

Further studies of Data Classification, Principal Investigator (with J. Burns and E. M. Cliff), FBI and Harris Corporation, Agmt 3938913, (\$70,000).

TRAIAN ILIESCU

Collaborative Research: Three-Dimensional Numerical Investigation of Density Currents , co-Principal Investigator, National Science Foundation, Grant DMS-0209309, September 2002 - August 2005, (\$94,829).

Computational Methods for Design, Control and Optimization of Micro Air Vehicles, Senior Investigator (with J. Borggaard, J. Burns, and E. Cliff), AFOSR, Grant F49620-02-C-0048 (\$600,000).

Scientific Computing Research Environments in Mathematical Sciences, co-Principal Investigator (with J. Borggaard), National Science Foundation, Grant DMS-0322852 (\$155,858).

GAIL LETZTER

Awarded NSA Mathematical Sciences Research Grant, Principal Investigator, The Representation Theory of Quantum Symmetric Pairs, March 2003-March 2005, \$30,461.

Quantum Symmetric Spaces and Their Zonal Spherical Functions, National Security Agency, two years, \$46,678.

Quantum Symmetric Spaces and Their Zonal Spherical Functions, National Security Agency, three years, \$222,346.

TAO LIN

“Highly Multiplexed Optical Fiber Sensing Networks for Infrastructure Monitoring”, NSF, (Co-PI with K. Cooper, G. Pickrell, A. Wang from ECE).

“Modeling electric propulsion plume-spacecraft interactions”, ERC, Inc., Electric Propulsion Group, U.S. Air Force Research Lab, (co-PI with Dr. J. Wang in AOE).

GWENDOLYN LLOYD

I have an Early Career Grant from the National Science Foundation. My project, titled “Building a Theory of Teacher Learning With and About Mathematics Curriculum: The Role of Innovative K-12 Materials in Elementary Teacher

Education,” spans the time period June 2000 to May 2005 with a budget of \$453,000.

Center for the Study of Mathematics Curriculum (CSMC) from the National Science Foundation-Centers for Teaching and Learning funding a multi-university project from 2004-2008, 10,000.00.

WAYNE PATTY

National Science Foundation grant (Systemic Reform of Mathematics K-5 for Virginia), April 1, 2000 – March 31, 2005, Principal Investigator, \$2,894,459

This is a Local Systemic Change (LSC) grant, and the purpose is to provide professional development for teachers in the participating school divisions in order to implement NCTM Standards-based, research-based curricula. The above dates include a one-year, no cost extension that we received in 2004.

FRANK QUINN

NSF grant for conference “Low dimensional topology” at the University of Virginia, Co-PI with Slava Krushkal \$12,000.

NSF grant DMS 0404848, “Controlled surgery” 7/04 – 8/06, \$72,000.

MICHAEL RENARDY

NSF-DMS Grant 04-05810, Principal Investigator, awarded in 2004, total amount \$124,954. Was informed by NSF that proposal ranked in the top 11 considered by the DMS Fluid Mechanics Panel.

Participating faculty mentor, NIH Grant 1R25GM066534-01A1, Virginia Post-baccalaureate Research and Education Program (PREP), PI Edward Smith (Animal and Poultry Science).

YURIKO RENARDY

National Science Foundation Chemical and Transport Systems. NSF-CTS 0090381. Title: “Interfacial processing for emulsions: droplet breakup with inertia,, non-Newtonian and surfactant effects: Principal Investigator, \$240,000. 3/1/2001-8/28/2004.

2003-2008: I am part of the National Institute of Health Grant 1R25GM066534-01A1 (PI Edward Smith, Department of Animal and Poultry Science) Virginia Tech Post-baccalaureate Research and Education Program (PREP).

National Science Foundation Chemical and Transport Systems. Title: Interfacial processing for emulsions: droplet breakup with inertia, non-Newtonian and surfactant effects. Principal Investigator: Yuriko Renardy. \$240,000. 2001-2004.

MARK SHIMOZONO

National Science Foundation Research Grant NSF-DMS 0401012, 6/4-5/04, \$94,584."Combinatorics in Representation Theory and Algebraic Geometry", My responsibility for this grant is 100%.

SHU MING SUN

National Science Foundation, Division of Mathematical Science, Grant Number: DMS-0309160. Title: "Three Dimensional Nonlinear Gravity Capillary Water Waves". \$116,000. Duration: August 1, 2003-July 31, 2006. Principal Investigator: S. M. Sun

DISTINGUISHED PROFESSIONAL SERVICE

JOSEPH BALL

Associate Editor for Proceedings of the American Mathematical Society (with the assistance of Professor Emeritus James E. Thomson): responsible for 134 articles submitted in 2004.

Associate Editor for Journal of Mathematical Analysis and Applications
Responsible for 18 articles submitted in 2004.

Associate Editor for Integral Equations and Operator Theory: responsible for 10 articles submitted in 2004.

EZRA BROWN

Nominated by the Department of Mathematics and the College of Science for an Alumni Distinguished Professorship.

Associate Editor, American mathematical monthly, 1992-present

JOHN BURNS

Editor, - Advances in Design and Control, 1998-present.

Associate Editor - Applied and Computational Control, Signals and Circuits, 1996-present.

DAVID GAO

Co-Editor-in-Chief for book series on *Modern Mechanics and Mathematics*, published by Chapman & Hall/CRC.

Co-Editor-in-Chief for book series of Advances in Mechanics and Mathematics, published by Kluwer Academic Publishers.

Associate editor for Journal of Global Optimization.
Kluwer Academic Publishers.

Editor for Discrete and Continuous Dynamical Systems, Series B. An International Journal Bridging Mathematics and Sciences.

Member of Editorial Board for Journal of Industrial and Management Optimization.

WILLIAM GREENBERG

Editorial Board, Transport Theory and Statistical Physics.

Editorial Board, International Journal of Evolution Equations

GEORGE HAGEDORN

Associate Editor, Journal of Mathematical Analysis and Applications.

TERRY HERDMAN

Editorial Board, Journal of Integral Equations and Applications.

MARTIN KLAUS

Co-Editor of the IWOTA 2002 proceedings

GWEN LLOYD

Editorial Board of the Journal for Research in Mathematics Education.

MICHAEL RENARDY

Editor, Zeitschrift fuer angewandte Mathematik und Physik.

Co-Editor, Mathematical Methods in the Applied Sciences.

Co-Editor, Advances in Differential Equations.

Co-Editor, Communications in Applied Analysis.

Co-Editor, International Journal of Differential Equations and Applications.

Co-Editor, SIAM Problems and Solutions (electronic publication).

Co-Editor, International Journal of Pure and Applied Mathematics.

Editor, EMS Monographs in Applied Mathematics.

YURIKO RENARDY

I am on the editorial committee of the following journals:
Journal of Non-Newtonian Fluid Mechanics 2002-2005;
The IMA Journal of Applied Mathematics 2002-2007.

ROBERT ROGERS

Member of co-editorial board of Journal of Applied Mathematics and Physics
(ZAMP)

EKKEHARD SACHS

Member of the Editorial Board of
SIAM Journal on Optimization
SIAM Journal on Control and Optimization
Mathematical Programming
Computational Optimization and Application
Optimization, Methods and Software

Member of Editorial Board of SIAM book series on Advances in
Design and Control

DEGREES AWARDED 2004

Abramson, Jessica - Spring
Ackley, Peter C. - Spring
Bacon, Andrea - Spring
Bailey, Jordan - Spring
Baird, Shannon – Spring
Bauer, Meredith - Fall
Blanchard, Seth – Spring
Bowers, Michael – Summer I – Dual
Brackett, Lakeshia – Summer I
Brown, Abby - Spring
Brown, Nicholas – Fall - Dual
Brunson, Jason Cory - Spring
Bugin, Matthew - Spring
Choi, Hyunjin - Spring
Cimorelli, Theresa - Spring
Cowden, Jason – Spring - Dual
Crabbe, Ryan – Summer I
Crowell, Michael – Spring – Dual
Donovan, Brian – Fall
Eriksson, Katherine - Spring
Errickson, Clifford – Spring
Ferguson, Kevin – Spring – DM
Fox, Eric – Summer II
Fuller, Timothy – Spring – DM
Gaertner, Nathaniel – Summer II
Gerhart, Matthew - Spring
Gibson, Susan Dawn - Spring
Graham, Andrew – Spring - Dual
Graziul, Christopher – Spring – Dual
Gummo, Mark – Spring - DM
Hanks, Jonathan – Spring - Dual
Harris, Donald - Spring
Hattery, Joshua – Spring – Dual
Hill, Latysha – Summer II
Horrigan, Kevin – Fall
Hou, Peter – Spring - Dual
Hurwitz, John – Spring - Dual
Ingram, Luke C. – Spring
Jawalkar, Nipun – Spring - Dual
Jesselli, Justin J. - Spring
King, Catherine - Spring
Krehbiel, Theodore - Spring
Lasken, Melisa - Spring
Lippa, Karl - Spring
Long, Stephen - Spring
Lowry, Carrie – Spring
Lu, WenChieh – Fall - Dual
Maciborski, Kaitlyn – Summer I

Mackie, Craig - Spring
Maldeis, Pamela L. – Spring
Marley, Jason – Summer II
Martin, Faith – Spring
Miller, Kirstine M. – Spring
Moy, Susan – Spring
Mull, James - Fall
Napenas, Mariah – Spring
Narkawicz, Anthony – Spring
Ndegas, Firmin – Spring - Dual
Nunnally, Beau – Spring
Oakes, Emory – Summer I
Ober, Todd – Spring
Orebaugh, Ashley – Spring
Oremland, Matthew – Spring
Propst, Natalie – Spring
Reichenbach, Christina – Spring
Richards, Paul – Spring
Ridberg, Nicole – Spring
Roberts, Melanie – Spring – DM
Roush, Marlene – Spring
Ruth, Mary - Spring
Scalera, James – Spring
Senske, Lauren – Spring
Sharp, Alison – Spring
Short, Jeffrey – Spring
Siu, Carlos – Spring – Dual
Sommervoll, Morten – Dual
Tokarz, John – Spring
Ward, Anna – Spring
West, Kelly – Spring
Winn, Victoria - Fall

Graduate Degrees Awarded - 2004

Master of Science

Audrey Doughty
Kimberly Heard

James Hicks
Mark Herman
Sharon Hughes
Pushkin Kachroo
Adrian Keister
Justin Krometis
Suresh Lanka
Micah Leamer
Kelly McLewin
Alexey Miroshnikov
Craig Starling
Eric Tressler
Scott Wagner
Thomas Weinhart

Doctor of Philosophy

Danny Cline
Tirivanhu Chinyoka
Stefan Forcey
Luis Garcia
Denise Krueger
Hoan Nguyen
Tapan Rai
Ivan Rothstein
Eric Vugrin

HONORS, AWARDS

SUSAN ANDERSON

I received the “Shockley-Layman Public Service Award” at our Department of Mathematics awards ceremony on April 27, which was given by two of our faculty members, James Shockley and John Layman, in appreciation of my

service to the campus and extended community over the years.

AGUD, DIANE

10 Years of service at Virginia Tech

JEFF BORGGAARD

Named “Professor of the Year” by Mathematics undergraduate students.

EZRA BROWN

Nominated by the Department of Mathematics and the College of Science for an Alumni Distinguished Professorship.

JOHN BURNS

Oishei Foundation Lecturer, Canisius College, Buffalo, NY, February, 2004.

DAVID GAO

Plenary speaker and scientific committee member for the 3rd *International Conference Optimization and Control with Applications* to be held in July 1-7, 2004, Chongqing, China.

Invited lecture for the 3rd *International Conference on Computational Modelling and Simulation of Materials*, May 29-June 4, 2004, Acireale, Sicily, Italy.

Plenary Lecture at the 3rd *International Conference on Optimization and Control with Applications*, July 26-31, 2004, Chongqing/Chengdu/Juzhaiguo, China.

Member of the editorial board appointed for Journal of Industrial and Management Optimization.

Scientific Committee Member for the 7th *International Conference on Optimization and Technology*, Ballarat University, Australia, 2004.

Scientific member for the 2nd *International Conference on Nonsmooth/Nonconvex mechanics*, Aristotle University of Thessaloniki (A.U.Th.), June 2004.

EDWARD GREEN

Principal Speaker at the 29th BLOC Conference, Leicester England, November 2004.

Principal Speaker at the 4th ARTIN Conference, Leeds, England, December 2004.

GEORGE HAGEDORN

2003-2004 Chaire Municipale de l'Université de Grenoble I. The City of Grenoble funded my one month visit to Institut Fourier during June 2004. This was the result of a university-wide competition at the Université de Grenoble I.

ABIGAIL KOHLER

Certificate of Teaching Excellence in the College of Sciences, February 2004.

Nominated for the Alumni Award in the College of Sciences, March 2004.

GAIL LETZTER

The 2003 Twente Conference on Lie Groups, University of Twente, The Netherlands, December 2003.

DEAN RIESS

I am a continuing member of the University Academy of Advising Excellence.

CATHERINE STEPHENS

Instructor of the Year-Spring 2004.

Enrollment Summary, Fall 2004 – Spring 2005

	Number of Sections	Enrollment	Average Section Size
*Courses below level of calculus	49	4,413	90.06
**First year calculus courses	111	5,553	50.03

Other undergraduate courses	202	8,311	41.14
Graduate courses	41	455	11.1
Total	403	18,732	46.48

Number of Undergraduate
Majors: 321
Number of Graduate Students: 78

* courses included: 1015, 1114,
1525

** courses included: 1016, 1205, 1224, 1526

**Undergraduate Semester Course Offerings
Fall '04 and Spring '05**

<u>Course Number</u>	<u>Title</u>	<u>Number of Sections</u>
1015	Elementary Calculus with Trig. I	16
1015*	Elementary Calculus with Trig. I	3
1015**	Elementary Calculus with Trig. I	1
1016	Elementary Calculus with Trig. I	14

1016*	Elementary Calculus with Trig. I	3
1016**	Elementary Calculus with Trig. I	1
1024	Mathematics, A Liberal Arts Approach	1
1034	Statistics, A Liberal Arts Approach	1
1114	Elementary Linear Algebra	20
1114H	Elementary Linear Algebra	3
1114**	Elementary Linear Algebra	2
1205	Calculus	34
1206	Calculus	40
1224	Vector Geometry	50
1224H	Vector Geometry	2
1525	Elementary Calculus with Matrices	8
1526	Elementary Calculus with Matrices	7
1535	Geometry & Math of Design	2
1536	Geometry & Math of Design	2
1614	Number and Computing for Teachers	2
1624	Geometry and Computing for Teachers	2
2015	Elementary Calculus with Trig. II	4
2016	Elementary Calculus with Trig. II	2
2214	Intro Differential Equations	30
2214H	Intro Differential Equations	2
2224	Multivariable Calculus	36
2224H	Multivariable Calculus	1
2534	Introduction to Discrete Mathematics	4
2644	Mathematical Tutoring	1
2984	SS: Linear Algebra	1
3034	Introduction to Proofs	6
3124	Modern Algebra	4
3134	Applied Combinatorics & Graph Theory	6
3144	Linear Algebra I	3
3214	Vector Calculus	7
3224	Advanced Calculus	5
3414***	Numerical Methods	2
3414	Numerical Methods	2
4044	History of Mathematics	1
4124	Introduction to Abstract Algebra	2
4134	Number Theory	1
4164	Advanced Discrete Mathematics	1
4175	Cryptography	1
4176	Cryptography	1
4225	Elementary Real Analysis	3
4226	Elementary Real Analysis	2
4234	Elementary Complex Analysis	1
4254	Chaos and Dynamical Systems	1
4334	College Geometry	3
4404****	Applied Numerical Methods	1
4414	Issues in Scientific Computing	1
4425	Fourier Series PDE	1

4426	Fourier Series PDE	1
4445	Introduction to Numerical Analysis	2
4446	Introduction to Numerical Analysis	2
4564	Operational Methods for Engineers	5
4574	Vector and Complex Analysis for Engrs.	4
4644	Secondary Math w/Tech	1
4654	Capstone Thesis and Seminar	1
4984	TS: Senior MAED Seminar	1
4984	TS: Applied Complex Variables	1

*VTASP Sections

**On-Line Course

***Taught by Computer Science

****Taught by AOE

Graduate Course Offerings Fall 2004 and Spring 2005

<u>Course Number</u>	<u>Title</u>	<u>Number of Sections</u>
5114	Specialized Topics in Algebra	1
5125	Abstract Algebra	1
5126	Abstract Algebra	1
5144*	Inverse Theory & Applications	1
5225	Real Analysis	1
5226	Real Analysis	1
5235	Complex Analysis	1
5236	Complex Analysis	1
5245	Differential Equations	1
5246	Differential Equations	1
5415	Topics: Numerical Optimization	1

5425	Ap Par Diff Equations	1
5426	Ap Par Diff Equations	1
5454	Graph Theory	1
5464	Combinatorics	1
5465	Numerical Analysis	1
5466	Numerical Analysis	1
5474	Finite Difference Mathematics	1
5484	Finite Element Methods	1
5485**	Numerical Analysis & Software	1
5486**	Numerical Analysis & Software	1
5495	Math Methods in Engr.	1
5496	Math Methods in Engr.	1
5515	Model & Simulation of Bio Systems	1
5516	Model & Simulation of Bio Systems	1
5524	Matrix Theory	2
5545	Calculus of Variations	1
5546	Calculus of Variations	1
5725	Math Finance Modeling	1
5726	Math Finance Modeling	1
5984	SS: Sem K-12 Math Ed Curr Refrm	1
6125	Topics: C*and Von Neumann Algebras	1
6126	Topics: C*and Von Neumann Algebras	1
6126	Topics: Mathematics of Cryptography	1
6225	Topics: Stochastic Processes	1
6226	Topics: Stochastic Processes	1
6255	Functional Analysis	1
6256	Functional Analysis	1
6425	Topics: PDE's and Sobolev Spaces	1
6426	Topics: PDE's and Sobolev Spaces	1
6426	Topics: Approx of Dynamical Systems	1

*Taught by Geology

**Taught by Computer Science