Mathematics Newsletter

Dr. Jeff Scroggs, Director
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News for the Undergraduate

www.math.ncsu.edu/undergrad
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Student Opportunities

The mathematics department invites all its undergrads to participate in various volunteer activities. These activities include mentoring incoming students; Hosting Spend-a-day visitors that join you in your classes; participating in the Undergraduate Program Review Committee to help guide us in developing the math programs; and other recruiting events.

Freshman Mentoring

This year, the College of Physical and Mathematical Sciences has extended mentoring to all freshmen. Incoming students (mentees) are matched with a continuing student (mentor). Mentors receive training that includes time management and study skills. Mentees are contacted several times, starting before they arrive for freshman orientation.

Scholarships

Departmental Scholarships are awarded several times throughout the year and based on academic accomplishment as measured by grade point average, adequate progress towards a degree in mathematics, and difficulty of the courses taken. Forms are available at www.math.ncsu.edu/undergrad/scholarships.

If you are interested in volunteering or becoming a Mentor, please contact Jeff Scroggs or Bisa Meek.

Spring '03 Electives

MA 325	Introduction to Applied Mathematics
MA 341	Applied Differential Equations I
MA 401	Applied Differential Equations II
MA 408	Foundations of Euclidean Geometry
MA 410	Theory of Numbers
MA 421	Introduction to Probability
MA 423	*Short-Term Actuarial Models
MA 426	Mathematical Analysis II
MA 432	*Mathematical Models in Life and Social Sciences
MA 437	*Applications of Algebra
MA 491h	*Reading in Honors Mathematics
MA 499	Independent Research in Mathematics
MA 501	Advanced Mathematics for Engineers and Scientists I
MA 502	Advanced Mathematics for Engineers and Scientists II
MA 512	Advanced Calculus II
MA 513	Introduction To Complex Variables
MA 515	Analysis I
MA 520	Linear Algebra
MA 521	Abstract Algebra I
MA 537	Nonlinear Dynamics and Chaos
MA 544	*Computer Experiments In Mathematical Probability
MA 547	Financial Mathematics
MA 555	Introduction to Manifold Theory
MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method
MA 591W (583)	Introduction to Parallel Programming
MA/BMA 574	*Mathematical & Experimental Modeling of Physical Processes II
MA/CSC 428	*Introduction to Numerical Analysis II
MA/CSC 580	Numerical Analysis I
MA/OR 505	Linear Programming

*These classes may be used for the math modeling requirement and differ for AMA and MA degrees.

Class times are listed at www.math.ncsu.edu/Courses/Sprg03.txt.

What's Inside

"Life is good for only two things, discovering mathematics and teaching mathematics"
-Siméon Poisson

CONGRATULATIONS

Spring 2002 Graduates

James Harley Bailey, Jr. ..... *Mathematics*
Heather Hayes Basnight ..... *Mathematics*
William Rex Beaudoin ..... *Mathematics*
Megan Elizabeth Early ..... *Mathematics*
Steven Christopher Habicht ..... *Mathematics*
Albert Earl Hopping ..... *Mathematics*
Alana Elizabeth Kirby ..... *Mathematics*
Nicholas Edward Long ..... *Mathematics*
Matthew Thomas Reiland ..... *Mathematics*
Juan Carlos Rodriguez ..... *Mathematics*
Brian Kerth Schuch ..... *Mathematics*
Joshua Ryan Smith ..... *Mathematics*
William Lawrence Switzer, IV ..... *Mathematics*
David Vincent Weaver ..... *Mathematics*

Adrian Cornelius Cox ..... *Applied Mathematics*
Leif Morgan Johnson ..... *Applied Mathematics*
Charles Edwin Killian, Jr. ..... *Applied Mathematics*
Joel Frederick Koerwer ..... *Applied Mathematics*
Nicole Raye O'Neal ..... *Applied Mathematics*
Renee Charise Pearson ..... *Applied Mathematics*
Richard Douglas Simmons, III ..... *Applied Mathematics*
Rosemary Shepherd Stallings ..... *Applied Mathematics*
Laura Elizabeth Taylor ..... *Applied Mathematics*
Brett Edward Unks ..... *Applied Mathematics*
Lucas Kyle Wagner ..... *Applied Mathematics*
Joseph Anton Wiggs ..... *Applied Mathematics*
Tracy Marsella Williams ..... *Applied Mathematics*
Nakia Louise Yarborough ..... *Applied Mathematics*

Spring 2002 Senior Awards

2002 College Senior Awards recognizes outstanding graduating seniors in three categories: Scholarly Achievement, Research, and Leadership. The Final selection is made by PAMS college administration. Three out of four recipients were Math Majors.

Scholarly Achievement
Rosemary Stallings (PY/ST/MA)

Research
Lucas Wagner (PY/MA)
Chip Killian, Jr. (CSC/MA)

2002 Duke Energy Technology
Scholarship Winners

Mark D. Sutton
Osama W. Alia
KeTrena S. Langhurst

The competition is campus-wide (in technology fields) for Juniors and Seniors. Duke Energy awards three students each year and often provides a summer internship. This year all three were Math Majors.

Pi Mu Epsilon

New Members for Spring 2002 were:

Jilleah Boroughs ..... *Mathematics*
Christine Finger ..... *Applied Mathematics*
Jennifer Guthrie ..... *Mathematics*
Mark Lavin ..... *Mathematics*
Nathaniel Lewallen ..... *Mathematics*
Xiaoci Guo ..... *Computer Science*
Yuanqing Ye ..... *Mathematics*
Chris Lipa ..... *Mathematics*

PHI BETA KAPPA

Math Students initiated Spring 2002.

Eliza J. Britt
Nicholas A. Featherstone
Greta S. Grizzard
Denise F. Hammock
Alexander Schlegel

"This paper gives wrong solutions to trivial problems. The Basic error, however, is not new."
-Clifford Truesdell

Math Honors Program

Six students, Megan Early, Chip Killian, Joel Koerwer, Nick Long, Billy Switzer and David Weaver, completed the math honors program in May, 2002. and Meghan O'Malley graduated last summer. Megan, Billy, David and Meghan are doing the 5 year BS/MS program in mathematics at NC State, Chip is doing a PhD program in computer science at Duke, Joel is doing a master's degree in optics in Japan, and Nick is doing graduate work in physics at the University of Maryland. Chip received an honorable mention for a National Science Foundation Fellowship.

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MA/CSC 583

Introduction to Parallel Computing

(Listed as MA 591w for registration)
Spring 2003, T/Th 11:20-12:35
Robert White
white@math.ncsu.edu

Students completing this course will be able to understand the message passing subroutines for parallel computations, implement an execute message passing codes related to matrix products, approximate the solutions of linear algebraic systems via domain decomposition, conjugate gradient and generalized minimum residuals, apply message passing to heat and mass transfer 2D space models.

MA 583 is an introduction to basic parallel architectures, algorithms and programming paradigms, message passing collectives and communicators, parallel matrix products, domain decomposition with direct and iterative methods for linear systems, analysis of efficiency, complexity and errors, applications such as 2D head and mass transfer.

Testing is 25% MPI Programming, 25% Parallel Algorithms, and 50% homework sets.

Prerequisites: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580.

MA 325

Introduction to Applied Mathematics

Spring 2003, MWF 12:25pm – 1:15pm
Robert White
white@math.ncsu.edu

This three-credit course will be a survey of applications of mathematics and will be suitable for students who have taken multivariable calculus. This course will enable the AMA student to formulate a cohesive plan of study for the third and fourth years, which includes 15-27 elective credits related to applied mathematics. Mathematics education majors will find the variety of applications and a sampling of teaching styles to be very interesting. Also, prospective majors in pure or applied mathematics will find this to be a good survey of applied mathematics beyond calculus. In the spring of 2002 there were five three-week modules on: Heat and pollutant transfer (*R.E. White*), Acoustic waves and boundary conditions (*H.T. Tran*), Cryptographic schemes (*E. Stitzinger*), Biological applications (*S. Lubkin*), Modeling of random phenomena (*J-P. Fouque*). Each module served as motivation for future course work and related academic activities.

Some mathematics will have to be developed "as needed," but it is not necessary to fully describe the mathematical analysis related to the applications. This can wait for a subsequent course.

MA 5 * *

Symmetry in Dynamics and Celestial Mechanics

Instructor: Dmitry Zenkov (dvzenkov@unity.ncsu.edu)

The presence of symmetry in mechanics allows one to effectively reduce the number of degrees of freedom of a mechanical system. The new, reduced system often demonstrates simpler dynamics and is thus easier to study. In this class we will focus on how one performs such a reduction and how this reduction can be used in mechanics and control.

We will start from an elementary concept of symmetry in dynamics and demonstrate that conservation of linear and angular momentum in mechanics can be derived from translational and rotational invariance of the system (this was already known in the 18th century by Lagrange). We will then discuss the modern concept of symmetry, which includes Lie group actions on configuration spaces and momentum maps. We will study how one performs reduction using the techniques of reduction by stages. We will then apply this technique to some problems of celestial mechanics.

The main model we will study is the three body problem. Recently, new exiting results have been obtained. One of them is applicable to the low energy trajectory design--using this approach it is possible to send a satellite near the vicinity of Sun, keep it there for years, and then return it back to Earth using almost no fuel. We will discuss how geometry helps to designs such trajectories. We will also discuss recently discovered choreographic motions in the many body problem. These are the periodic motions in which all bodies trace the same curve without colliding. The shapes of some of these curves are quite unexpectable; for example three equal masses can travel a fixed "figure eight" shaped curve.

**This course does not have an assigned course number yet.*

MA 544

Computer Experiments in Mathematical Probability

Spring 2003, M/Th 11:20am-12:25pm
Instructor: Jack Silverstein

This class will explore the benefits of using computers to gain insight into mathematical behavior. Examples will be chosen from topics in probability theory which are not typically covered in other courses or which do not have a complete mathematical treatment at this time. For further details go to www.math.ncsu.edu/~jack/ma544.html.

New Faculty

Agnes Szanto: I am from Budapest, Hungary. I first came to the US in 1993 to start my Ph.D. at Cornell University. After I finished my Ph.D., I had postdoctoral positions in Berkeley, Vancouver, and in Canterbury, U.K. My area of research is symbolic computation. I am presently working on algorithms for the solution of non-linear equation systems.

Min Kang: My research interest includes probability theory and partial differential equations, in particular, interacting particle systems and stochastic partial differential equations. I received my Ph.D. at Cornell University, spent one year at the Fields Institute in Toronto, Canada and was a Ralph Boas Assistant Professor at Northwestern University before I joined the department of mathematics at NCSU.

Robert Buche: I am from the Division of Applied Mathematics from Brown University where I earned my Ph.D. and was a visiting research associate. My main research interest is in the area of stochastic processes and their applications, particularly in control and communications systems. I live in Apex with my wife Laurie and baby Alex.

Tao Pang: I was born in Shandong, China. I went to University of Science and Technology of China (USTC) in 1990, and got my B.S. (1994) and M.S. (1997) in Mathematics. I got my Ph.D. in Applied Mathematics at Brown University in May, 2002. My research interests include Stochastic Control Theory, Financial Mathematics, Applied Probability, etc.

Alina Chertock: I graduated from the Moscow State University in 1989 and received my Ph.D. in Applied Mathematics (Tel-Aviv University) in 1999. I was a postdoc fellow at the Lawrence Berkeley National Laboratory and a visiting assistant professor at the Department of Mathematics at the University of California, Berkeley, from 1999 until 2002. My current research centers around free boundary problems for nonlinear PDEs, focusing on analytic asymptotic methods and high-resolution numerical methods, numerical methods for time dependent PDEs, hyperbolic conservation laws, degenerate parabolic equations, and numerical analysis. I live with my husband Boris and my son Dani. I like theater and ballet, and dancing myself.

Negash Medhin: I am a graduate of Purdue university. I taught at Clark Atlanta University, Atlanta. My research interests include developing molecular based models for hysteresis in elastomers, and control theory. I am also currently working in applications of control theoretic techniques in the analysis o selective bond breaking in molecules through infrared excitation. I am married to Cheryll Bowman Medhin, who is currently registrar at Georgia Perimeter college, Decatur Campus.

Running and Running

Mathematics Professor Tom Lada became the NC Senior Games State Champion in the 800m run (2:44) and the 1500m run (5:38) on October 5 at NCSU's Paul Derr Track. He won both events in the 55-59 age bracket.

Originally from New Britain, Connecticut, Tom ran track and cross country in high school and also in college at Holy Cross. He continued to jog, run, and train following college and began to race again (road racing this time) in the mid 1970s with fellow Math Department colleague Bob Ramsay. Dr. Lada has run 15 marathons, his most recent being in 1983; his best tine is 2 hours, 57 minutes. In fact, it was during a marathon race when Tom experienced severe chest pains only to find out later that he had a large tumor in his chest cavity attached to his heart and lungs. Not to be slowed by such a "minor" setback, he began running short races within several months o the ensuing surgery and was back to a full race schedule the following year.

He still trains virtually everyday implementing a regimen of intervals, long runs, and weight training. He runs weekly track meets in the summer as a member of the Godiva Track Club and does extensive road racing (5K's and 10K's). He also competes with other NCSU faculty on a team that competes with the likes of IBM, Glaxxo, and DuPont.

Recently inspired by 80- and 90-year-old runners in this year's Senior Games competition, Dr. Lada has the long range goal of running and training well beyond the young age of 56.

By John Griggs

The mathematical facts worthy of being studied are those which, by their analogy with other facts, are capable of leading us to the knowledge of a physical law. They reveal the kinship between other facts, long known, but wrongly believed to be strangers to one another.

- Jules Henri Poincaré

Can You Solve This?

1. Let P_1 and P_2 be regular polygons of 2002 sides and perimeters *x* and *y* respectively. Each side of P_1 is tangent to a given circle of circumference *c* and this circle passes through each vertex of P_2. Prove that $x + y \geq 2c$.

2. Determine the function $F(x)$ which satisfies the functional equation $x^2 F(x) + F(1-x) = 2x - x^4$ for all real x.

3. Prove that if $x + \frac{1}{x} = 2\cos\alpha$, then $x^n + \frac{1}{x^n} = 2\cos n\alpha$.

Please submit answers to Bisa Meek in Harrelson 255

Solutions to Spring 2002 *Can You Solve This?*

1. Let $0 < u < 1$ and define $u_1 = 1 + u,\ u_2 = \frac{1}{u_1} + u,\ \cdots,\ u_{n+1} = \frac{1}{u_n} + u,\ n \geq 1.$

Show that $u_n > 1$ for all values of $n = 1,2,3,\ldots$

courtesy Bob "Rocky" Ramsay
ramsay@math.ncsu.edu

Solution: We show by induction that $1 < u_n \leq 1 + u,\ n = 1,2,3,\ldots.$ First, note that $1 < u_1 \leq 1 + u$. Now assume $1 < u_k \leq 1 + u$. Then $\frac{1}{1+u} \leq \frac{1}{u_k} < 1,$

so we have $1 < 1 + \frac{u^2}{1+u} = \frac{1+u+u^2}{1+u} = \frac{1}{1+u} + u \leq \frac{1}{u_k} + u < 1 + u.$

Brent Dozier submitted a slightly different solution to this problem also using mathematical induction.
Good Job, Brent!!

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2. A Wolf standing at the center of a circular arena sees a Tarheel at the wall. The Tarheel runs around the wall and the Wolf purses it along a unique path, which is determined by running at the same speed and staying on the radial line joining the center of the arena to the Tarheel. Show that the Wolf overtakes the Tarheel as it reaches a point one-quarter of the way around the arena.

Solution: Using polar coordinates, let the center of the arena be the origin, the radius of the arena be R, and assume the Tarheel runs counterclockwise starting from $(R,0)$. When the Wolf is at the point (r,θ), the Tarheel is at the point (R,θ), and by equating the speeds, we get $\sqrt{\left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\theta}{dt}\right)^2} = R\,\frac{d\theta}{dt},$

which implies that $\frac{dr}{\sqrt{R^2 - r^2}} = d\theta.$

Solving this, using initial condition $r = 0, \theta = 0,$ we get $r = R\sin\theta,$

which is the circle of radius $\frac{R}{2}$, center $\left(\frac{R}{2}, \frac{\pi}{2}\right)$.

Thus they meet when $\theta = \frac{\pi}{2}$.

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3. If a,b,c denote the lengths of the sides of a triangle show that $3(bc + ca + ab) \leq (a+b+c)^2 < 4(bc + ca + ab)$.

Solution: The left inequality holds for any three positive numbers, since

$$(a+b+c)^2 - 3(bc+ca+ab)^2 = \frac{1}{2}\left[(a-b)^2 + (b-c)^2 + (c-a)^2\right] \geq 0.$$

To prove the second inequality, we use the triangle inequalities $c + a > b,\ a + b > c, b + c > a$ to deduce that $|a - b| < c,\ |b - c| < a,\ |c - a| < b,$

Hence, $4(bc + ca + ab) - (a+b+c)^2 = c^2 - (a-b)^2 + a^2 - (b-c)^2 + b^2 - (c-a)^2 > 0.$

Honors

Continued from Page 2

Chris Flake and Luke Cherveny attended the Budapest Semesters in Mathematics last spring and Jason Blevins is attending this semester, bringing to 11 the number of NC State students who have participated in the Budapest Semesters. In addition, Jason Blevins, Luke Cherveny, Chris Flake, Chris Lipa, Meghan O'Malley and Pat Barrow did math REU's (Research Experiences for Undergraduates, sponsored by NSF) last summer at Colorado School of Mines, Trinity University, Nebraska, Cornell, Penn State and Indiana, respectively. In addition, Pat is participating in the Mathematics Advanced Study Semesters at Penn State this fall. Several of these students will be presenting their research to the faculty and students sometime this fall. Dates and times will be announced.

Students participating in the Math Honors Program are encouraged to attend study abroad programs such as the Budapest Semesters in Mathematics or the Math in Moscow program as well as do math research at NC State and in summer programs such as the NSF sponsored Research Experiences for Undergraduates (REU"S). In the last 10 years, 22 math majors have done summer REU's at schools including Rutgers, U of Illinois, Lafayette College, Hope College, Rose-Hulman, Oregon State, Florida State, Colorado School of Mines, Penn State, U of Washington, U of Puerto Rico, and Indiana. As a result 9 students have received NSF Fellowships for graduate study. In fact, for NSF Fellowships in math since 1994, we're ranked 12th nationally, tied with Harvey Mudd, U of Chicago, U of Illinois at Chicago and U of Washington. Graduate schools attended by our students include Princeton, MIT, Stanford, NYU, Cornell, Wisconsin, Rutgers and several other schools.

Song Zhong and Joseph Wagner will graduate in December, 2002. Students joining the honors program last spring include Steven Farrar, Mark Harris, Jay Hodges, Dmitri Morozov, Alex Schlegel, Nick Vance and Joseph Wagner. Twenty-eight students are currently participating in the Math Honors Program and invitations to join the program will be extended sometime during pre-registration. Students interested in more information about the program should contact Dr. Paur, HA 202, 515-2598, sopaur@math.ncsu.edu or check out the honors program web site; http://www.math.ncsu.edu/honors.

By Sandy Paur

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