

## Claire M. Tomesch

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### EDUCATION

Class of 2007  
Honors Program in Mathematics, B.S./M.S.  
Science and Humanities Scholars Program  
Carnegie Mellon University  
Pittsburgh, PA

GPA: 3.93 / 4.00  
Mathematics: 3.92 / 4.00  
Physics: 4.00 / 4.00

High School Diploma, June 2003  
Villa Walsh Academy  
Morristown, NJ

GPA: 4.4 (4.0 weighted scale)

### AWARDS

Dr. J. Paul Fugassi and Linda Monteverde Award, Mellon College of Science, Carnegie Mellon University  
Awarded annually to the graduating female student in the Mellon College of Science with the most outstanding academic achievement and professional promise.

Accepted a McCormick Fellowship from the Mathematics Department, the University of Chicago  
Offered a Clarendon Scholarship, covering fees and living expenses for three years, at University of Oxford  
Member of Phi Beta Kappa, Upsilon of Pennsylvania chapter at Carnegie Mellon University  
2007 Andrew Carnegie Society Scholar – \$1500 award to fund additional academic endeavors  
U.S. Department of Homeland Security Scholarship Award

In recognition of academic accomplishments, research interests, and potential professional contribution to the mission and objectives of the Department, this award provides full tuition and fees for the remaining two years of undergraduate work – approximately \$65000, a ten-week internship during the summer of 2006 at a Department approved facility paying a \$5000 stipend, and a \$1000/month stipend for the nine months of the academic year

Selected for the Honors Degree Program in Mathematics

A demanding program which leads to both the B.S. and M.S. in Mathematics in four years. The key element in this program is the Mathematical Studies sequence, a concentrated and accelerated set of courses which students enter in the fall of the sophomore year by invitation. Admission to the graduate stage of the program during the junior year is again by invitation; the Department will, in this invitation, hold to the same high standards which apply to admission to any graduate program. During the course of completing the masters portion of the program, students take a minimum of five graduate courses from the three general categories of: analysis; algebra, logic, topology, and geometry; and applied mathematics; and complete a masters thesis.

Science and Humanities Scholar – interdisciplinary honors program at Carnegie Mellon University  
Designed to enable talented students to develop an undergraduate curricular program that builds upon their interests and achievements in the humanities, natural sciences, and mathematics.

Andrew Carnegie Scholarship – half tuition, approximately \$15,000 annually

Awarded to those who exhibit excellence in academic and/or artistic achievement, receive exemplary recommendations from teachers and counselors, enhance their school or local community through personal involvement, and demonstrate an impressive sense of personal integrity; within top one percent of applicants.

National Merit Scholarship – \$1000 annually

Dean's List with High Honors – all semesters

Admitted to the Carnegie Mellon Chapter of the Honor Society of Phi Kappa Phi, Fall 2005

Admitted to Eta Chapter of Lambda Sigma, national sophomore honor society dedicated to service

National AP Scholar, AP Scholar with Distinction – 2003; AP Scholar with Honor – 2002

Merck State Science Day 2003 – 5<sup>th</sup> place individual statewide in the Physics Competition

Catholic High School Math League (28 school consortium): 1<sup>st</sup> place individual, Varsity B Level, 2003

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### ACTIVITIES

CMUMC: Carnegie Mellon University Math Club, Library Committee Chair, 2005-2007

Reformed for Spring 2005 semester; worked with the faculty adviser, John Mackey, mathematics lecturer, during the planning stages, Fall 2004; currently head of the library committee, responsible for providing a complete set of materials both physical and online to supplement the resources of the university library system, Career Center, and Fellowship Resource and Advising Center for those interested in mathematics at all levels.

Teaching Assistants' Assistant for Matter and Interactions I, Fall 2004/5, and II, Spring 2005/6

Matter and Interactions I and II constitute an honors physics sequence for incoming freshmen, emphasizing the derivation of results from fundamental principles and atomic-level description and analysis. Bridge the transition from mastery of course material to the ability to cohesively instruct and guide learning in the discipline: assist students with integrating new concepts into existing body of knowledge, programming assignments, problem sets, and experiments during scheduled recitations; hold weekly sessions for additional instruction.

Mellon College of Science College Council, Undergraduate Representative, Fall 2005 and Spring 2006

The MCS College Council meets two times a semester and reviews all academic proposals within the Mellon College of Science. Its membership consists of the Dean, Associate Deans, the four Department Heads, one faculty representative, one graduate student representative, and one undergraduate student representative.

Computing Services Student Advisory Council, MCS representative, Spring 2005/6/7 and Fall 2005/6

Women's Leadership Program 2004, Carnegie Mellon University

All University Orchestra, Carnegie Mellon University (first violin, 2003-2007)

volunteer: Phipps Conservatory and Botanical Gardens (2003-2005)

Society of Women Engineers (member, 2003-2007)

Delbarton Abbey Orchestra (first violin, 2001-2003; second violin, 1999-2001)

Independent AP Studies (exam score): Art History (4); Calculus AB (5), BC (5);

Environmental Science (5); European History (5); Physics C: Mechanics (5);

Physics C: Electricity & Magnetism (5); United States Government and Politics (4)

New Jersey High School Math League (1999-2003)

Catholic High School Math League, division: J.V. B (1999-2002); Varsity B (2002-2003)

### SUMMER SESSIONS

Research, Pacific Northwest National Laboratories, Richland, WA

Advisor: Dr. Joseph Oliveira, [jso@pnl.gov](mailto:jso@pnl.gov)

Eleven weeks of doing research in pure mathematics, with an eye towards its application in steganography, cryptography, and data compression. Broadly, my research centered on translating the theory and machinery of cubic lattices into the language of commutative algebra; specifically, some of the results I obtained included proving that the set of face ideals of the Stanley ring of a multicube form a cubic lattice by giving an explicit expression for the delta operator and giving an explicit geometric construction on a simplex which can be used to compute delta via its embedding into an n-cube, making explicit the symmetries involved and showing its dependence purely on codimension. The research also branched from these topics and considered sheaves over multicubes and the connection with binary symmetric functions. We plan on continuing this research during the academic year 2006/7.

Research Experience for Undergraduates, University of Notre Dame, South Bend, IN

Organizers: Dr. Frank Connolly, Dr. Michael Gekhtman [research advisor]

Research Partner: Zachary Madden

Seven week program concentrating on research pertaining to rank one conditions and soliton solutions to the KP hierarchy. Specifically sought and produced conditions on the matrices which are used to generate tau functions sufficient to obtain a tridiagonal Lax operator and also extended to the case of finite-band operators. Also included specialized mini-courses in algebra and topology.

Program for Women in Mathematics: Geometry of Groups Institute for Advanced Study, Princeton, NJ

Organizers: Dr. Karen Uhlenbeck, Dr. Chuu-Lian Terng

Lecturers: Dr. Ruth Charney, Dr. Karen Vogtmann, Dr. Tara Brendle, Dr. Indira Chatterji

An intensive eleven day workshop, held from 16-27 May 2005, including lecture courses, problem seminars, and research talks on topics in geometric group theory, specifically geometric group actions, quasi-isometry, CAT(0) spaces, cube complexes, and groups acting on trees and spaces of trees. Also prominent were discussions focused on mentoring, graduate and post-graduate advising, peer relations, and career opportunities.

Mathematics and Science Intern: New Jersey SEEDS Program 2004, Delbarton School, Morristown, NJ

References: Mr. Robert Loia, rloia@delbarton.org

Mr. Russell Goodrich, rgoodrich@delbarton.org

In partnership with competitive secondary schools, the Young Scholars Program of New Jersey SEEDS provides opportunities for highly motivated, academically qualified, economically disadvantaged students through a cohesive program of academic enrichment and subsequent assistance with placement in independent schools for seventh grade. Team taught mathematics classes, tutored in mathematics and science, and assisted with laboratory demonstrations; served as role model for talented students who otherwise might not have been encouraged to study mathematics and science.

Mathematics Tutor, Delbarton Summer Session 2004, Delbarton School, Morristown, NJ

Reference: Mrs. Kelly Gleason, kgleason@delbarton.org

Lead intensive small group instruction in high school mathematics and enrichment topics to prepare students for more challenging courses by previewing material, to help students master previous coursework before moving forward, and to hone critical thinking skills.

New Jersey Governor's School of Engineering and Technology, Rutgers University (2002)

Exposed to the various disciplines available in engineering, as well as the demands faced in these diverse fields; provided not only with a thorough understanding of the various disciplines, but also an awareness of the importance that engineering and technology have in both one's professional and personal life; provided challenging weekly schedules and as a result caused me to become familiar with the rigors, efforts and rewards encountered by students in an engineering curriculum; offered stimulating and challenging courses, laboratory workshops, research projects, tours and trips, colloquia to discuss new ideas.

Douglass Science Institute for Women in Math, Science, and Engineering (1999, 2000, 2001)

Douglass College of Rutgers University, New Brunswick, NJ

Summer residential program for young women entering ninth through eleventh grade who want to explore a variety of areas including biology, chemistry, engineering, physics, mathematics, along with computer, environmental, and marine science; learned about career options in math, science, and engineering by engaging in hands-on labs, workshops, and field trips and by talking with undergraduates, Rutgers University faculty, and women working in science in the corporate world.

#### REFERENCES

Dr. James Cummings  
jcumming@legba.math.cmu.edu

Dr. Joseph Oliveira  
jso@pnl.gov

Dr. Helmut Vogel  
vogel@heps.phys.cmu.edu

Dr. Steve Awodey  
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Dr. Richard Holman  
rh4@andrew.cmu.edu

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CARNEGIE MELLON COURSEWORK

MATHEMATICS COURSEWORK	GRADE	CREDITS
21127 Concepts of Mathematics D'Angelo & West, <i>Mathematical Thinking</i>	A	3.0
21131 Analysis I Apostol, <i>Calculus, Volume 1</i>	B	3.3
21132 Analysis II Apostol, <i>Calculus, Volume 1</i>	A	3.3
21201 Undergraduate Colloquium [two semesters]	P	.3 + .3
21235 Mathematical Studies I Rudin, <i>Principles of Mathematical Analysis</i> Dummit & Foote, <i>Abstract Algebra</i>	A	6.7
21236 Mathematical Studies II Spivak, <i>Calculus on Manifolds</i> Dummit & Foote, <i>Abstract Algebra</i> Halmos, <i>Finite-Dimensional Vector Spaces</i>	A	6.7
21295 Putnam Seminar [two semesters]	A	1.0 + 1.0
21301 Combinatorics Matousek & Nešetřil, <i>Invitation to Discrete Mathematics</i>	A	3.0
21325 Probability Ross, <i>A First Course in Probability</i>	A	3.0
21372 Partial Differential Equations	A	3.0
21465 Topology and Geometry Munkres, <i>Topology</i>	A	3.0
21599 Reading and Research, Advisor: Dr. Joseph Oliveira, jso@pnl.gov	A	3.0 + 3.0
21602 Introduction to Set Theory Kunen, <i>Set Theory: An Introduction to Independence Proofs</i>	A	4.0
21610 Algebra	A	4.0
21640 Introduction to Functional Analysis	B	4.0
21715 Commutative Algebra Atiyah & MacDonald, <i>Introduction to Commutative Algebra</i>	A	4.0
21720 Measure & Integration Schwartz, <i>Analyse mathématique</i>	A	4.0
21804 Mathematical Logic Seminar	audit	2.0
21901 Masters Degree Research, Advisors: Dr. Handron, Dr. Cummings	A	1.0 + 5.0
80713 Category Theory Awodey, <i>Category Theory</i>	A	4.0
80820 Categorical Logic Moerdijk & MacLane, <i>Sheaves in Geometry and Logic</i>	A	3.0

PHYSICS COURSEWORK	GRADE	CREDITS
33131 Matter and Interactions I	A	4.0
33132 Matter and Interactions II Chabay & Sherwood, <i>Matter and Interactions: Volumes 1 &amp; 2</i>	A	4.0
33211 Physics III: Modern Essentials Taylor & Wheeler, <i>Spacetime Physics: Introduction to Special Relativity</i>	A	3.3
33234 Quantum Mechanics Tipler & Llewellyn, <i>Modern Physics</i>	A	3.3
33499 Supervised Reading: Vector Bundles and K-Theory Hatcher, <i>Vector Bundles and K-Theory</i> ; Atiyah, <i>K-Theory</i>	A	3.0
33755 Quantum Mechanics I Cohen-Tannoudji, <i>Quantum Mechanics</i>	A	4.0
33758 Quantum Computation and Quantum Information Nielsen & Chuang, <i>Quantum Computation &amp; Quantum Information</i>	A	4.0

### 21235/6 MATHEMATICAL STUDIES I & II

A unified and intensive presentation of algebra, analysis, and geometry by a team of instructors. Aims at providing a modern background in mathematics for a career in pure or applied mathematics, science, or engineering. Topics covered include analysis in  $\mathbb{R}$ , analysis in Euclidean spaces, linear algebra, geometry, algebraic theories, multi-linear algebra, and ordinary differential equations. Covers and extends the material taken up in the following courses:

#### 21259 Calculus in Three Dimensions

Vectors, lines, planes, quadratic surfaces, polar, cylindrical and spherical coordinates, partial derivatives, directional derivatives, gradient, divergence, curl, chain rule, maximum-minimum, multiple integrals, Green-Gauss Theorems.

#### 21341 Linear Algebra I

Fields, vector spaces, subspaces, linear independence, basis and dimension, matrices and linear equations, linear transformations, groups, rank and nullity theorem, change of basis, inner product spaces, eigenvalues and eigenvectors. Inner products: angle and orthogonality, Gram-Schmidt orthogonalization, orthogonal transformations. Determinants: existence and uniqueness, multiplication theorem. Theory of a single linear transformation: basic concepts, invariant subspaces, triangular form theorem, rational and Jordan canonical forms. Dual vector spaces and multilinear algebra: quotient and dual spaces, bilinear forms and duality, direct sums, tensor products, elementary divisor theorem. Orthogonal and unitary transformations: structure of orthogonal transformations, principal axis theorem, unitary transformations, spectral theorem for self-adjoint and normal transformations. Applications to differential equations.

#### 21355 Principles of Real Analysis I

Real number system: field and order axioms, sups and infs, completeness, integers and rational numbers. Real sequences: limits, cluster points, limsup and liminf, subsequence, monotonic sequences, Cauchy's criterion, Bolzano-Weierstrauss Theorem. Topology of the real line: open sets, closed sets, density, compactness, Heine-Borel Theorem. Continuity: attainment of extrema, Intermediate Value Theorem, uniform continuity. Differentiation: chain rule, local extrema, Mean-Value Theorems, L'Hopital's Rule, Taylor's Theorem. Riemann integration: partitions, upper and lower integrals, sufficient conditions for integrability, Fundamental Theorem of Calculus. Sequences of functions: pointwise convergence, uniform convergence, interchanging the order of limits.

#### 21356 Principles of Real Analysis II

Topology in metric spaces, specialization to finite dimensional normed linear spaces. Vector differential calculus: continuity and the total derivative, partial derivatives, directional derivatives, gradients, Jacobians, the chain rule, implicit function theorem. Vector integral calculus: double and triple integrals, arc length and surface area, line integrals, Green's Theorem, surface integrals, divergence, and Stokes Theorems. Trigonometric series, Fourier series for orthonormal bases, minimization of square error.

#### 21373 Algebraic Structures

Groups: homomorphisms, subgroups, cosets, Lagrange's Theorem, conjugation, normal subgroups, quotient groups, first isomorphism theorem, group actions, Cauchy's Theorem, dihedral and alternating groups, the second and third isomorphism theorems. Rings: subrings, ideals, quotient rings, first isomorphism theorem, polynomial rings, prime and maximal ideals, prime and irreducible elements, PIDs, UFDs, Noetherian domains, Gauss' lemma, Eisenstein criterion. Fields: field of fractions of an integral domain, finite fields. Applications to cryptography, coding and number theory.