

<b>Department and Course Number<sup>1</sup>:</b>	<b>MATH 395</b>
<b>Submitting Unit:</b>	<b>MATH</b>
<b>Date Submitted:</b>	

**UCC/GPSC FORM 301:**

\* *Superscripts identify appropriate sections in Instructions for Completing Forms 302 and 302.  
Don't forget that boxes expand.*

<b>Submit New Course:</b>	<b>X</b>
<b>Revise Existing Course:</b>	
<b>Reinstate Dropped Course:</b>	

*(To drop a course, use Form 302)*

**Course Information:**

*Complete all parts of the column below for the new, existing, or reinstated course.*

<b>Dept. &amp; Course No.<sup>1</sup>:</b>	<b>MATH 395</b>
<b>Course Title<sup>2</sup>:</b>	
<b>Seminar in Problem Solving</b>	

**Catalogue Description<sup>3</sup>:**

Systematic approach to solving non-standard and competition level math problems on inequalities, infinite sums and products, combinatorics, number theory, and games.
<i>Identify any registration or credit restrictions<sup>4</sup>:</i>
None

**Revised Course Information:**

*Use this column only for revisions to an existing or reinstated course; complete only changed parts.*

<b>Dept. &amp; Course No.<sup>1</sup>:</b>	
<b>Course Title<sup>2</sup>:</b>	

**Catalogue Description<sup>3</sup>:**

<i>Identify any registration or credit restrictions<sup>4</sup>:</i>

<b>Unit Value<sup>5</sup>:</b>	<b>2,</b> <b>max 8</b>
<b>Instruction Mode<sup>6</sup>:</b>	Lecture, hrs/week: <b>2</b>
	Discussion, hrs/week:
	Laboratory, hrs/week:
	Quiz, hrs/week:
Other:	

<b>Course is<sup>7</sup>:</b>	an elective: <b>X</b>
a degree requirement for:	
for general education credit:	
for diversity credit:	

<b>Preparation<sup>8</sup>:</b>	
Prerequisite(s):	<b>none</b>
Corequisite(s):	<b>none</b>
Recom. preparation:	<b>Math 126</b>
Concurrent Enrollment:	<b>none</b>
Duplicates credit in:	<b>none</b>
Cross-listed as:	<b>none</b>

<b>Grading Option<sup>9</sup>:</b>	Letter: <b>X</b>
	CR/NC:
Other:	

<b>Unit Value<sup>5</sup>:</b>	
<b>Instruction Mode<sup>6</sup>:</b>	Lecture, hrs/week:
	Discussion, hrs/week:
	Laboratory, hrs/week:
	Quiz, hrs/week:
	Distance learning:
Other:	

<b>Course is<sup>7</sup>:</b>	an elective:
a degree requirement for:	
for general education credit:	
for diversity credit:	

<b>Preparation<sup>8</sup>:</b>	
Prerequisite(s):	
Corequisite(s):	
Recom. preparation:	
Concurrent Enrollment:	
Duplicates credit in:	
Cross-listed as:	

<b>Grading Option<sup>9</sup>:</b>	Letter:
	CR/NC:
Other:	

**Term(s) offered<sup>10</sup>:**

fall:	<b>X</b>
summer:	
spring:	
other:	

**Term(s) offered<sup>10</sup>:**

fall:	
summer:	
spring:	
other:	

**Name(s) of Proposed Instructor(s)<sup>11</sup>:**

<b>Richard Arratia, Sergey Lototsky</b>
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If not taught by full-time faculty, check and provide justification for course being taught by non-full-time faculty.:	
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**Name(s) of Proposed Instructor(s)<sup>11</sup>:**

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If not taught by full-time faculty, check and provide justification for course being taught by non-full-time faculty.:	
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**Syllabus<sup>12</sup>:** *Provide a detailed syllabus for the new, revised, or reinstated course (the last used syllabus may be submitted if appropriate for a reinstated course);.*

**Syllabus.**

A traditional mathematics course on a particular subject puts emphasis on theory and exercises, while paying little attention to problems. This is not surprising because a good mathematical problem is usually beyond the scope of any particular subject. Solving such a problem requires special skills that are not taught in any regular course.

The objective of the current course is to teach the students a systematic approach to solving non-standard math problems that require knowledge of various areas of mathematics. Upon a successful completion of the course the students will

- Learn a number of useful facts from various areas of mathematics not usually discussed in the regular courses on the subject and learn to apply the knowledge to solve a specific problem.
- See mathematics as a single discipline rather than a collection of different subjects.
- Get the experience in collaborative work solving challenging problems.
- Get the confidence and skills necessary to approach a problem they never saw before.

With minimal pre-requisites for the course, the material will include topics from all major branches of mathematics, and the students should expect most of the material to be new and unfamiliar. Systematic treatment of some of the course topics, such as inequalities, plane and solid geometry, polynomials, and the theory of games, is not found in any of the existing mathematical courses. Other topics come from the algebra, analysis, combinatorics, number theory, and probability. Each of these five areas of mathematics is a subject of a separate 400-level course that puts little emphasis on problem solving. As a result, the current course does not duplicate but rather complements and enhances the existing mathematics curriculum at USC, and, in fact, can be a good preparation for students who plan to take any upper-division mathematics course.

**Week-by-week schedule.**

Week 1: Basic inequalities (rearrangement, arithmetic/geometric mean, Cauchy-Schwartz)

Week 2: Establishing inequalities using calculus methods (extreme values and convexity).

Week 3: Computations (limits, sums, products, integrals)

Week 4: Analysis (continuity and differentiability)

Weeks 5 and 6: Probability and combinatorics, including combinatorial identities.

Weeks 7, 8, and 9: Algebra and number theory (abstract algebra, prime numbers, rationals and reals)

Week 10: Polynomials (factorization and roots)

Weeks 11: Plane geometry.

Week 12: Solid geometry.

Weeks 13 and 14: Mathematical theory of games. (mathematical approach to analyzing simple games)

**Assignments:** regular homework assignments will be handed out on weeks 1, 3, 5, 10, 11, and 13, with respective due dates on weeks 3, 5, 7, 11, 12, and 14. Each homework will include 5-6 problems and exercises on the current material. A mid-term project on number theory (8-10 problems) will be given on week 7 with due date on week 9; a comprehensive final exam consisting of 10-12 problems will be given two weeks before the end of the semester and will be due on the scheduled date of the final exam.

**Collaboration** will be encouraged on all assignments under the following rules: (1) The solutions to be turned in must be written individually by each student; (2) The student must list the names of collaborators for each problem. There are two main reasons for encouraging collaboration: (1) A serious mathematical discovery is often a result of a collaborative effort, and one of the goals of the course is to convey this idea of collaboration to the students, (2) Most problems are challenging enough even for experienced mathematicians.

**Grading:** six regular homework assignments (50 %), one midterm projects (15%), final project (25%), class participation (in-class presentation of solved or new unsolved problems) (10%). Grading will be merit-based rather than on a curve, and students repeating the course for credit are held to a higher standard. In particular,

- All students will make several in-class presentations. For first-time students, we expect at least three such presentations during the semester; for experienced students, this expected number will increase by one for each additional time they take the class.
- Most of the problems on the assignments will involve proofs, and the standard for writing the proofs will be higher for the experienced students than for the first-timers.
- Most assignments will include extra-credit problems. The expectation of good performance on these problems will be proportional to student's prior experience in the class; in particular, extra-credit problems will be completely optional for the first-timers.

**Other information:** While the syllabus lists the main topics to be covered, the list is general enough, and, depending on the interests of the instructor and the participating students, the particular material discussed in the class may vary significantly from year to year. And, with a virtually unlimited supply of problems from various mathematics competitions, the assignments will not be repeated from year to year. Students who intend to repeat the course in the following year are expected to put in extra effort, in the form of active class participation and better than average performance on the assignments, during the current year. Whether a particular student can repeat the course for credit is at the sole discretion of the instructor.

Students with disabilities are encouraged to seek assistance at the University Disability Services and Programs (DSP). The contact information for DSP is below.

Assistant Director: Mattie Grace  
Learning Disabilities Specialist: Tammy Tucker  
Coordinator: Katherine Hammons  
(213) 740-0776 (voice)

(213) 740-6948 (TTD)  
 Student Union Building 301  
 Email: [ability@usc.edu](mailto:ability@usc.edu)  
[www.usc.edu/student-affairs/asn/DSP](http://www.usc.edu/student-affairs/asn/DSP)

**The official textbook:**

Loren C. Larson, L. C. Larson *Problem Solving through Problems*  
 ISBN: 0387961712  
 Format: Paperback, 352pp  
 Pub. Date: January 1994  
 Publisher: Springer-Verlag New York, LLC

**Recommended additional reading:**

- T. Andreescu, R. Gelca, *Mathematical Olympiad Challenges*, Birkhauser, 2000.
- E. R. Berlekamp, J. H. Conway, R. K. Guy, *Winning Ways for Your Mathematical Plays*, Academic Press, 1982
- G. H. Hardy, J.E. Littlewood, G. Pólya, *Inequalities*, Cambridge University Press, 1988.
- K. Hardy, K. S. Williams, *The Green Book of Mathematical Problems*, Dover, 1997.
- K. Hardy, K. S. Williams, *The Rreen Book of Mathematical Problems*, Dover, 1997.
- K. Kedlaya, B. Poonen, R. Vakil, *The William Lowell Mathematical Competition 1985-2000: Problems, Solutions, and Commentary*, American Mathematical Society, 2002.
- S. G. Krantz, *Techniques of Problem Solving*, American Mathematical Society, 1997.
- G. Pólya, *How to Solve It: A New Aspect of Mathematical Method*, Princeton University Press, 1971.
- I. Reiman, *International Mathematical Olympiad, 1959-1999*, Anthem Press, 2001.

**Reason for Creating, Revising, or Reinstating the Course<sup>13</sup>:**

Student participation in the extracurricular activities of the math club and in the annual Putnam Math competition indicates a strong interest in non-standard math problems among both math and non-math majors. Currently, no course at USC addresses the needs and interests of those students.

**Date for first implementation<sup>14</sup>:** Fall 2004

**Signatures of Requesting Units<sup>15</sup>:**

<i>Printed Name</i>	<i>Office, mc</i>	<i>Phone/e-mail</i>	<i>Date</i>
Primary Staff Contact for Unit: <b>Amy Yung</b>	DRB 142, mc 1113	x0-8168/amy@usc.edu	
Primary Faculty Contact for request: <b>Sergey Lototsky</b>	DRB 258, mc 1113	x0-2389 lototsky@math.usc.edu	
<i>Printed Name and Signature of Chair and Dean</i>	<i>Office, mc</i>	<i>Phone/e-mail</i>	<i>Date</i>

Chair/Director of Requesting Unit: <b>Wayne Raskind</b>	DRB 166, mc 1113	x0-3799 raskind@math.usc.edu	
Dean of School/Designee:			

**List of Departments that may be affected by requested changes<sup>16</sup>:** obtain signatures below

**No department other than mathematics is affected.**

**Review by Chairs/Deans of Affected Unit(s)<sup>17</sup>:**

<i>Printed Name and Signature</i>	<i>Unit</i>	<i>Favorable/neutral/ have reservations*</i>	<i>Date</i>

*\* If there are reservations, attach or submit comments to Curriculum Coordination Office.*

**Undergraduate Curriculum Committee (UCC)  
 Graduate and Professional Studies Committee (GPSC)  
 Curriculum Coordination Office  
 STO 227, mc 0912  
 Phone: (213) 740-1162, FAX: (213) 740-1507, e-mail: [curriclm@usc.edu](mailto:curriclm@usc.edu)**