

Title: **Problem solving seminar**

Spring 2013

Math 388 - 3 credits

**Pre-requisite:** 223, 233, 239, and two 300-level MATH courses.

**Degree requirements:** This course will satisfy the degree requirements of Math 348, but will not satisfy the 300-level elective requirement of the mathematics department.

**Course description:** This seminar will provide an opportunity for participants to hone mathematical problem solving skills through challenging problems from across the mathematical curriculum. Students will work individually and in teams on problems which will demand both creativity and the ability to integrate their accumulated knowledge of various branches of mathematics.

**Course outline:**

- Discussion of problem solving techniques (pigeonhole, combinatorial proof, invariants, analogy, etc., as per Polya's, *How To Solve It.* ) and/or fundamental theorems in mathematics (fundamental theorems of algebra, arithmetic, isomorphisms, calculus, etc; Jordan matrix decomposition, Taylor expansions, binomial theorem, fixed point theorems, analytic continuation, Heron's formula, four centers of triangles, theorems from probability, etc).
- Practice with problem solving. This may focus on one or more of the following:
  - Individual problem solving on problems involving general mathematics knowledge,
  - Collaborative problem solving on challenging GRE-level and Putnam-level problems from across the curriculum,
  - Technology-based problem solving.
- Each student will choose one significant problem to present at GREAT Day or another setting to fulfill the Oral Research and Presentation requirement (Math 348 credit).

**Learning outcomes:** Students will

- 1) solve problems, particularly from calculus, linear algebra, real analysis, and abstract algebra.
- 2) demonstrate their content knowledge of the core mathematics courses by giving clear and logically correct solutions to problems.
- 3) apply a variety of advanced problem solving techniques.
- 4) perform mathematical experiments, write conjectures, and justify or disprove them.
- 5) critique mathematical presentations.
- 6) produce a mature oral presentation of a non-trivial mathematical topic.

**Bibliography:**

- Blanchard. *Problem solving with Excel and Matlab.* <http://blanchard.ep.wisc.edu/>
- Garrity. *All the Mathematics You Missed: But Need to Know for Graduate School.*
- Gelca & Andreescu. *Putnam and beyond.*
- Honsberger. *In Pólya's Footsteps.*
- Laczkovich. *Conjecture and proof.*

- MAA Ohio section. *Notes from CONCUR Swap Session on Senior Capstones: Fall 2008 Meeting.*  
[sections.maa.org/ohio/ConcurSwapSession.pdf](http://sections.maa.org/ohio/ConcurSwapSession.pdf)
- Polya. *How to solve it.*
- SUNY Potsdam. *General Mathematical Knowledge Problems – Spring 2008.*
- SUNY Potsdam. *Presentation problems – Spring 2012.*