

Syllabus for MA 310-001
Mathematical Problem Solving for Teachers
(For Elementary and Middle School Majors Only)
Spring 2008

Course: MA 310-001, TR 9:30–10:45, Dickey Hall 355

Instructor: Carl Lee

Office: 967 Patterson Office Tower

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Email: lee@ms.uky.edu

Office Hours: TR 11:00–12:15, and by appointment.

Text: G. Polya, *How to Solve It*, Princeton, 2004.

Personal Web Page: <http://www.ms.uky.edu/~lee>

Moodle Web Page: <http://moodle.ms.uky.edu/moodle>. Moodle is a course management tool that I will use to keep you up-to-date on your grades in the course, and to post course materials. If you took MA241 in Fall 2007 you can use your same login and password. Otherwise, your login is your *original UK email address*, and your password is your student ID.

Class Attendance and Participation: This class is designed for active involvement of the students. You will be actively supporting each other as you gain experience and understanding. Multiple ideas and points of view are important. You will benefit from hearing others' approaches to problem solving, and they will benefit from you. So attendance and active participation are expected and contribute toward your grade.

Homework: There will be frequent homework assignments, usually assigned weekly. Most homework assignments will consist of problems to solve and write up, and reflections on

certain techniques of problem solving.

Two assignments will be a little different, however. One will consist of a set of problems to be done individually in class, designed to probe mathematical knowledge of various types for teachers—I plan to use one of the DTAMS instruments from the University of Louisville. The other consists of a mathematical connections one-on-one interview in which you will be asked to solve certain problems and explain your solutions. In both of these cases, you will receive a grade simply for participating.

Exams: At this point I am planning to have two or three exams during the semester.

Final Exam: Tuesday, April 29, 8:00 am, in our regular room, DH 355.

Grading:

Class attendance and participation	10%
Homework	45%
Exams	30%
Final	15%

Working Together: It is ok to work together on homework. However, when it comes time for you to write up the solutions, I expect you to do this on your own, and it would be best for your own understanding if you put aside your notes from the discussions with your classmates and wrote up the solutions entirely from scratch. Working together on exams, of course, is expressly forbidden.

Absences: An excuse for an absence must be presented in writing no later than two weeks prior to the date of the absence. An absence due to illness or family emergency may be excused, provided that you can supply acceptable written evidence if required, and that you notify me *as soon as possible*. Notification is almost always possible immediately upon occurrence of an emergency. If you're too sick to telephone, you can get a friend to do it. Failure to make such timely notification may result in denial of your request. For an explanation of valid excused absences, refer to U.K.'s *Student Rights and Responsibilities*.

Cheating: Cheating and plagiarism can lead to significant penalties. See *Student Rights and Responsibilities* for further information.

Expectations: I expect that everyone will maintain a classroom conducive to learning. I like an informal atmosphere, but it must be orderly. Thus, everyone is expected to behave with basic politeness, civility, and respect for others. In particular, talking in class is ok if it's part of a class discussion or directed to me. Private communications are not, especially during quizzes and tests. Neither are reading extraneous materials, using electronic equipment, or sleeping.

Suggestions: Suggestions for improvement are welcome at any time. Any concern about the course should be brought first to my attention. Further recourse is available through the offices of the Department Ombud and the Department Chair, both accessible from the Main Office in 715 Patterson Office Tower.

Associated Research: During the semester you may be invited to participate in a research project in mathematics education. The details will be provided later, but your participation or non-participation is strictly voluntary and has absolutely no bearing on your grade in the course.

Course Content:

My desires are well reflected in this statement of Polya from the introduction to his book *How to Solve it*:

A great discovery solves a great problem but there is a grain of discovery in the solution of any problem. Your problem may be modest; but if it challenges your curiosity and brings into play your inventive faculties, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery. Such experiences at a susceptible age may create a taste for mental work and leave their imprint on mind and character for a lifetime.

Thus, a teacher of mathematics has a great opportunity. If he fills his allotted time with drilling his students in routine operations he kills their interest, hampers their intellectual development, and misuses his opportunity. But if he challenges the curiosity of his students by setting them problems proportionate to their knowledge, and helps them to solve their problems with stimulating questions, he may give them a taste for, and some means of, independent thinking.

Also a student whose college curriculum includes some mathematics has a singular opportunity. This opportunity is lost, of course, if he regards mathematics as a subject in which he has to earn so and so much credit and which he should

forget after the final examination as quickly as possible. The opportunity may be lost even if the student has some natural talent for mathematics because he, as everybody else, must discover his talents and tastes; he cannot know that he likes raspberry pie if he has never tasted raspberry pie. He may manage to find out, however, that a mathematics problem may be as much fun as a crossword puzzle, or that vigorous mental work may be an exercise as desirable as a fast game of tennis. Having tasted the pleasure in mathematics he will not forget it easily and then there is a good chance that mathematics will become something for him: a hobby, or a tool of his profession, or his profession, or a great ambition.

The author remembers the time when he was a student himself, a somewhat ambitious student, eager to understand a little mathematics and physics. He listened to lectures, read books, tried to take in the solutions and facts presented, but there was a question that disturbed him again and again. "Yes, the solution seems to work, it appears to be correct; but how is it possible to invent such a solution? Yes, this experiment seems to work, this appears to be a fact; but how can people discover such facts? And how could I invent or discover such things by myself?" Today the author is teaching mathematics in a university; he thinks or hopes that some of his more eager students ask similar questions and he tries to satisfy their curiosity. Trying to understand not only the solution of this or that problem but also the motives and procedures of the solution, and trying to explain these motives and procedures to others, he was finally led to write the present book. He hopes that it will be useful to teachers who wish to develop their students' ability to solve problems, and to students who are keen on developing their own abilities.

**MA 501-201 — SEMINAR IN SELECTED TOPICS:
TOPICS IN GEOMETRY
FALL 2007**

NOTE: This syllabus is not in final form; I may need to make some changes in the future.

INSTRUCTOR:

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TEACHING ASSISTANT:

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SYNCHRONOUS MEETINGS:

Adobe Connect, via the website <http://connect.math.wvu.edu>.
Test Session: Thursday, August 16, 7-8 pm.
Regular Sessions: Thursdays, August 23 through December 6, 7-9 pm, with the exception of Thursday, November 22 (Thanksgiving).

ASYNCHRONOUS COURSE MANAGEMENT:

Moodle, via the website <http://moodle.math.wvu.edu>.

COURSE WEBPAGE:

<http://www.ms.uky.edu/~lee/ma501fa07/ma501fa07.html>

TEXTS:

1. Dunham, W., *Journey Through Genius*, Penguin, ISBN-10: 014014739X, ISBN-13: 978-0140147391.
2. Course notes, available from the website.
3. You should also get a copy of some college geometry text to refer to.

TOPICS: We will treat several major themes in geometry, including some aspects of their historical development, their appearances in school curricula, and use of some software to aid in visualization.

GRADING:

- Presentations — written and oral: 20%
- Threaded discussion: 5%
- Synchronous participation: 5%
- Homework: 25%
- Midterm: 20%
- Final exam: 25%

WEEKLY COURSE SCHEDULE:

- Thursday — Begin asynchronous threaded discussion via Moodle
- Tuesday, 11 pm — Complete asynchronous discussion
- Thursday 7–9 pm — Synchronous session via Adobe Connect
 - Follow-up from threaded discussion
 - Project presentations from class members
 - Discussion of reading
 - Discussion of homework
- Sunday — Submit homework, uploaded to Moodle by 11 pm.

ASYNCHRONOUS DISCUSSION: Topics will be posted on the course Moodle site, and participants are expected to make substantive contributions and responses to others' contributions.

PRESENTATIONS: Presentations will be made by groups of 1–3 course members during the synchronous sessions accompanied by a written report. Each course member will participate in one of these. Topics and details on the nature of these presentations will be posted later on the course Moodle site.

READING: Readings and some related questions will be posted on the course Moodle site, and participants are expected to complete all of the reading before the synchronous session, ready to engage in discussion on the questions.

HOMEWORK: Assigned and completed weekly, uploaded to Moodle in a single file. You may discuss the problems with other current class members and with me. However, when it comes time for you to write up the solutions, I expect you to do this on your own. If you receive assistance from someone else, include a written acknowledgment. Such an acknowledgment is a professional courtesy and will not affect your grade.

EXAMS: There will be a comprehensive (up to that point) midterm exam, and a comprehensive final exam. Either or both of these exams will be expected to be completed in a proctored timed format, administered to you by a trusted individual who will receive the exam from me. I will provide more information on this later.

IMPORTANT DATES:

August 21 — Tuesday — Last day a student may officially drop a course or cancel registration with the University Registrar for a full refund of fees.

August 23 — Thursday — First synchronous session.

August 28 — Tuesday — Last day to add a class for the 2007 Fall Semester.

August 28 — Tuesday — Last day to officially withdraw from the University or reduce course load and receive an 80 percent refund.

September 3 — Monday — Labor Day - Academic Holiday.

September 12 — Wednesday — Last day to drop a course without it appearing on the student's transcript.

September 19 — Wednesday — Last day to officially withdraw from the University or reduce course load and receive a 50 percent refund.

October 15 — Monday — Midterm of 2007 Fall Semester.

October 19 — Friday — Last day to withdraw from the University or reduce course load. Students can withdraw or reduce course load after this date only for "urgent non-academic reasons."

November 21 — Wednesday — Fall Break - Academic Holiday.

November 22-24 — Thursday through Saturday — Thanksgiving — Academic Holidays.

December 6 — Thursday — Final synchronous session.

December 10-14 — Monday-Friday — Final Examinations Week.

TUITION: As usual, ACCLAIM will pay for half of the in-state tuition for the course, and you are responsible for paying the other half. If there are unusual circumstances concerning your tuition and how it will be paid, contact Professor Vena Long immediately.

MA/STA 515 — LINEAR AND COMBINATORIAL OPTIMIZATION
MWF 3:00–3:50 — CB347

COURSE WEBPAGE: www.ms.uky.edu/~lee/ma515fa07/ma515fa07.html

INSTRUCTOR: Carl Lee, 967 POT, 257-1405, lee@ms.uky.edu, www.ms.uky.edu/~lee

OFFICE HOURS: MWF 2:00–2:50 and by appointment, since I realize that some of you will be unable to come at these times. Also, I may need to schedule some additional formal times for the class to meet, since there are some class days when I will be out of town.

TEXT: Jon Lee, *A First Course in Combinatorial Optimization*, Cambridge, 2004. I will also prepare some course notes.

TOPICS:

1. Chapter 0: Polytopes and Linear Programming
2. Chapter 1: Matroids and the Greedy Algorithm
3. Chapter 2: Minimum-Weight Dipaths
4. Chapter 3: Matroid Intersection
5. Chapter 4: Matching
6. Chapter 5: Flows and Cuts
7. Various miscellaneous topics as time permits

GRADING:

Homework: 50%

Exams: 30%

Final: 20%

HOMEWORK: Usually collected weekly, but some problems may be collected more frequently. From time to time I will give additional homework assignments for the graduate students enrolled in the course that will not be required of the undergraduate students. Problems are assigned to be solved. Searching the textbooks or the library for solutions is not permitted. On regular assignments you may discuss the problems with other current

class members and with me. However, when it comes time for you to write up the solutions, I expect you to do this on your own. If you receive assistance from someone else, include a written acknowledgment. Such an acknowledgment is a professional courtesy and will not affect your grade.

EXAMS: There will be two or three exams (tentative dates: September 24, October 15, and November 14) and a final exam (December 10, 1 pm). One or more of these may be take-home exams.

IMPORTANT DATES:

August 21 — Tuesday — Last day a student may officially drop a course or cancel registration with the University Registrar for a full refund of fees.

August 28 — Tuesday — Last day to add a class for the 2007 Fall Semester.

August 28 — Tuesday — Last day to officially withdraw from the University or reduce course load and receive an 80 percent refund.

September 3 — Monday — Labor Day - Academic Holiday.

September 12 — Wednesday — Last day to drop a course without it appearing on the student's transcript.

September 19 — Wednesday — Last day to officially withdraw from the University or reduce course load and receive a 50 percent refund.

October 15 — Monday — Midterm of 2007 Fall Semester.

October 19 — Friday — Last day to withdraw from the University or reduce course load. Students can withdraw or reduce course load after this date only for "urgent non-academic reasons."

November 21 — Wednesday — Fall Break - Academic Holiday.

November 22-24 — Thursday through Saturday — Thanksgiving — Academic Holidays.

December 10 — Monday — Final Exam, 1 pm.

CHEATING AND PLAGIARISM: Cheating and plagiarism are not worth it, and they are damaging to your self-integrity, so don't do it. Here is the website with information on University policies: <http://www.chem.uky.edu/research/grossman/acadoffenses/index.htm>.

MA 614 — ENUMERATIVE COMBINATORICS
MWF 12:00–12:50 — CB347

COURSE WEBPAGE: www.ms.uky.edu/~lee/ma614sp07/ma614sp07.html

INSTRUCTOR: Carl Lee, 967 POT, 257-1405, lee@ms.uky.edu, www.ms.uky.edu/~lee

OFFICE HOURS: MWF 11:00–11:50 and by appointment, since I realize that some of you will be unable to come at these times. Also, I may need to schedule some additional formal times for the class to meet, since there are some class days when I will be out of town.

TEXT: Richard Stanley, *Enumerative Combinatorics, Volume I*, Cambridge, 2006.

TOPICS: An introduction to the basic notions and techniques in enumerative combinatorics. Topics include generating functions, principle of inclusion and exclusion, bijections, recurrence relations, partially ordered sets, the Möbius function and Möbius algebra, Lagrange inversion formula, the exponential formula and tree enumeration.

Tentative Course Outline:

1. Generating functions
2. Stirling numbers of the first and second kind
3. Permutations and permutation statistics
4. q -analogues
5. The twelve-fold way
6. Principle of inclusion-exclusion
7. Partially ordered sets and lattices
8. The fundamental theorem of distributive lattices
9. The incidence algebra
10. The Möbius inversion formula
11. The Möbius function and computational techniques
12. The Möbius algebra

13. Semi-modular lattices and hyperplane arrangements
14. The zeta polynomial
15. Rank-selection
16. R -labelings
17. Eulerian posets
18. *Exponential generating functions
19. *The exponential formula
20. *Tree enumeration
21. *Lagrange inversion formula

*These topics are treated in Chapter 5 of Stanley's *Enumerative Combinatorics*, volume 2.

Other Useful References:

1. J.H. van Lint and R.M. Wilson, *A Course in Combinatorics*.
2. R.P. Stanley, *Enumerative Combinatorics*, volume 2.
3. H.S. Wilf, *Generatingfunctionology*.

GRADING:

Homework: 50%
Exams: 30%
Final: 20%

HOMEWORK: Usually collected weekly, but some problems may be collected more frequently. Problems are assigned to be solved. Searching the textbooks or the library for solutions is not permitted. On regular assignments you may discuss the problems with other current class members and with me. However, when it comes time for you to write up the solutions, I expect you to do this on your own. If you receive assistance from someone else, include a written acknowledgment. Such an acknowledgment is a professional courtesy and will not affect your grade.

EXAMS: There will be two or three exams and a final exam (April 30).

IMPORTANT DATES:

Wednesday, January 10, First day of classes

Wednesday, January 17, Last day to add a class

Wednesday, January 31, Last day to drop a class without a grade

Monday–Saturday, March 12–17, Spring break—no classes

Friday, March 9, Last day to withdraw from a class

Friday, April 27, Last day of classes

Monday, April 30, 1:00 p.m., Final exam.

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