Math 8 - Course Outline, 2009 Spring Quarter.

LECTURES: MWF, 10:00 AM - 10:50 AM, PHELP 1448.

INSTRUCTOR: Pawel Gladki.

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OFFICE HOURS: **M 9:00 AM - 10:00 AM, T 1:00 PM - 3:00 PM** If you want to see your instructor in his office, you are encouraged to make an appointment: see him before or after class, call his office or send him an e-mail.

LECTURES AND DISCUSSIONS: Most of the course is developed through problem solving and discovery. This class is supported by a grant from Educational Advancement Foundation, that was set up by mathematicians and scientists who believe that the best way to teach mathematics is to have students learn the big ideas through inquiry instead of listening to lectures in a hall with hundreds of other students.

The basic objective of this class is to teach you how to write proofs and properly express your ideas in a language understood by other mathematicians. In general, we do not use a textbook: the instructor will pose questions and you will work on them. Everybody will be expected to present his/hers ideas on a chalkboard in a way that can be understood by other classmates – expect heaps of questions from your instructor and other students while presenting your ideas. It will be OK to work in groups, but of **no more than 2 students** – unlike some other inquiry based classes that you might have taken (e.g. Math 3CI/5AI/5BI), you **are NOT** supposed to work in large groups here: instead of working on a project with a group of friends, you will be learning here how to write proofs and present your own ideas, and that cannot be really done in a crowd of people. While working on these problems you have to agree on two basic rules: (1) **do NOT consult textbooks,** and (2) **do NOT consult the Internet.**

Other that studying proof techniques, you will also have your first experience in working with some more serious mathematical texts, in particular with books that were not necessarily written as college textbooks. Each of you will be supposed to present to the rest of the class a theorem or a part of the theory that will require use of some literature. In the early stage of the class you will be provided with source materials by your instructor, however towards the end of the quarter you will be expected to go to the library and find necessary materials on your own.

You are expected to devote a spiral notebook to the class. This way you can keep all your work bound in sequence. We ask you to record **all your ideas and calculations in this notebook,** IN INK, and indicate the date when you start work for the day. Don't be shy about errors, when you realize something is wrong, just write OOPS beside it and go on. If you don't have false starts, then you are not engaging in inquiry and the instructor will be concerned. Your notebook will contain everything, scribbles and false starts, good ideas, great ideas, re-writes of something you have fixed up, as well as notes taken in class. If you write up something on a computer or print out data from a computer, don't recopy it into the notebook – just stable it in. Your notebook does not have to look nice and clean, but **it has to contain all the math associated with this class**. At the end of the course, you notebook will be collected as evidence of your class work and it may be collected for brief intervals during the term as well.

EVALUATION: Your grade will be based on class participation (20%), homework and notebook (30%), one midterm (20%) and a final (30%). During class we will discuss how the exams will be structured, they will be a combination of take-home and in-class exams. You will have homework after each class, but it will not be provided to you as a list of problems to work on. Sometimes the homework will consist of exercises for practice, one or two problems to be studied in depth. Most often it will simply consist of an assignment to think about where we are in class, work on it more, and what ideas you might try next. Your homework should be written down **in your notebook as well,** and if we go over it in class, you can write corrections down next to it. If you miss a class, phone a classmate to find out what happened or email one of the instructors.

Material to be covered:

(1) Natural deduction (the truth value of a proposition, negation, conjunction, alternative, implication, sufficient and necessary conditions, logical equivalence).
(2) Set theory (sets and classes, algebra of sets, properties of sets and natural deduction, Venn diagrams).
(3) Quantifiers (predicate symbols, universal and existential quantifier, properities of quantifiers, de Morgan laws).
(4) Natural numbers (Peano axioms, the axiom of mathematical induction, proofs by induction, theorems equivalent to the axiom of mathematical induction).
(5) Real numbers (natural numbers, integers, rationals, irrationals, real numbers – groups, rings and fields).
(6) Field of complex numbers.
(7) Relations (types of relations, orders and equivalences, equivalence classes, modular arithmetics).
(8) Functions (functions as relations, domain and codomain, functions that are one-to-one and onto).
(9) Cardinality (sets of the same cardinal number, Cantor-Bernstein theorem, Cantor's theorem, cardinality of integers and real numbers, continuum hypothesis).
(10) *(if time permits)* Zermelo-Fraenkel set theory (Zermelo-Fraenkel axioms and the axiom of choice, equivalent formulations of the axiom of choice: Zorn's Lemma, Zermelo's theorem, well-ordering principle).