MATH 430 FALL 2013

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Office Hours: MW 2:15 – 3:15, Tu 1:15 – 3:30, and by appointment

Course Hours: 11 - 11:50 MWF in KAP 158

Text: Elementary Number Theory (7th ed.) by David Burton
We will cover most of Chapters 1 – 9, and some additional material as time permits.

Prerequisite: Math 126 is the listed prerequisite but little of its material is actually required. Math 126 guarantees some experience with studying and doing mathematics.

Grading: Homework assignments (about twelve during the semester) = 25% of the course grade. Two midterm exams (10/9 and 11/13) and the final exam (12/11 from 11 – 1) each = 25% of the course grade. The letter grade on the final exam may replace half of the letter grade on one other graded part.

Course Material and Goals:

Number theory is an interesting and appealing subject. It has many important applications and connections with other areas of mathematics (e.g. coding theory, sphere packing, geometry, and analysis), but this course will focus on an introduction to basic and important ideas in the subject. The two main goals of the course are to learn some number theory and to gain some experience in doing proofs. The latter involves learning to think precisely and to deal with abstraction. Some consequences of results in the course, via calculation by hand, are: write the greatest common divisor of 20,869 and 30,031 as $s \cdot 20{,}869 + t \cdot 30{,}031$ for integers s and t; find the remainder when $17^{1{,}000{,}000{,}000{,}000{,}000}$ is divided by 19; find in how many ways 100,000,000 can be written as positive integer multiples of 19 and 41; show that there are 12 consecutive positive integers so that each is divisible by a cube bigger than 1; determine which integers are sums of two integer squares; determine if 187,563,903,645,903 can be written as the sum of three integer squares; find the largest power of 7 that divides 100,002!

Most students have little prior experience in writing proofs. Learning to do proofs can be challenging; it takes some effort and time. One must keep working at it, but it (slowly) becomes easier to do. Justification of statements (proof!) is intrinsic to modern mathematics and so is a requirement for any substantial study of mathematics. This aspect of the course is useful for careful and critical thinking in general, and also is preparation for further proof oriented courses, such as Math 410, Math 425a, or Math 440. The essential prerequisite for writing proofs is an absolute command of the definitions and theorems presented in the course: these *must be memorized*. Precise knowledge and easy recall of definitions and theorems was likely not important in most previous math courses you have taken, so you may need to change your approach here to studying mathematics.

Expectations:

Students are responsible for the material *presented in class and on the homework assignments*; the text is for reference. A lot of what we do will be deriving computational procedures for solving certain problems. You need to work on the assignments to practice these procedures, and you need to master the underlying material, both to justify the procedures and to write proofs. Consequently, definitions and the statements of theorems (and other results) are an *essential* part of the course. Exams will use and ask for these, and might also ask for a proof, or an outline of a proof, of a result from class. You should *study the material presented in class*. I cannot emphasize too strongly the importance of *memorizing* the definitions and theorems. Knowing the definitions makes understanding subsequent material more likely, often helps to see how to start a proof, and is essential to do many proofs. The theorems are the tools needed to justify problem solutions and to prove other statements: they give connections between various facts and ideas. Constructing a proof entails connecting what you are given with what you want to conclude, and the only usable connections are the theorems and definitions.

Mastering the definitions and theorems, and working on problems can be quite time-consuming. In my experience, for a student to do well in a course like Math 430, it is typically *not* sufficient to spend only three or four hours each week out-of-class to study the material and to work on problems—some students may find that substantially more time than that may be required.

Advice on Homework:

It is *very* important to work on as many problems as you can. Their purpose is to provide practice with the concepts and with the techniques to solve certain kinds of problems, and to illustrate use of the theorems—so to help remember the results proved in the course. Thus, attack these problems with the lecture material and text at hand: *problems are about the material in the course*. In particular, problem solutions *must* use *only* the material presented in class, other than for standard elementary arithmetic and algebra. Problems on the homework sheets could appear on exams.

It is best to look over the homework when it is handed out, and to work on it over some days rather than the night before it is due. In that way you can ask questions about it, and get hints for solutions, in a timely manner.

When you write out solutions to the problems, *you **must** give appropriate reasons for the statements you make, with clear reference to results from class or to definitions, where appropriate*. This is good practice for learning to think carefully and precisely, and again, it reinforces the learning of the material. If you are unable to find a specific result or definition that justifies a statement or step you make, then that step is likely to be incorrect. In writing arguments, explain how two consecutive statements or expressions are related.

It may be possible to find solutions of homework problems online, from friends, or at the Math Center, but doing so will almost certainly *not* help you to solve exam problems. Learning how to attack a given math problem seems to require previous "pencil and paper" work, yourself, on related problems; simply seeing problems worked out is not typically sufficient for doing problems on an exam.

It is best in math courses not to put off to a later time trying to understand things—that usually leads to falling farther behind and making subsequent material harder to grasp.

Academic Integrity

The exams are "closed book" and no notes, calculator, consulting with others, or copying from others is allowed, unless otherwise indicated by me. Since the *graded homework problems* count toward the course grade, their solutions should be yours alone. *For those homework problems to be handed in for grading, you may not copy solutions to them from anyone else, get solutions from any source other than me, or allow others to copy your solutions*. Here, "copying" is to be interpreted in the broadest sense—changing from an x to y is still copying. Violations of this policy are *extremely* serious.

I am happy to try to accommodate your schedule and work with you to find times when you are able to come to my office for help with the course material or homework—I offer hints/solutions as needed. Feel free to see me about any matter relating to the course, mathematics in general, or just to chat (I have cookies in my office!).

Mathematics, especially number theory, is interesting and fun, but may take some time and work to become sufficiently comfortable in dealing with it and appreciating it.