Math 454-001
Math 553-001

Graph Theory and Applications
Discrete Applied Mathematics I

Fall 2009

	Time	Location
Lecture	TR 11:25-12:40am	Eng. 1 Bld. 106

Instructor: Robert Ellis, Assistant Professor of Applied Mathematics

Office Info: Eng. 1 Bldg. Rm. 105C, 567-5336, rellis"aht"math·iit·edu (with appropriate modification)

Office hours: MW 11am-4:15pm, Walk-in
TR 1:50-4:30, By Appointment

Come to office hours having read background material related to your question, and having attempted any homework problem you have a question about. You may send detailed questions by email, but allow for delay in response after hours and on weekends. I encourage you to request joint appointments so that more people can benefit from the discussion. Any changes to office hours will be posted on the course homepage.

Course Home Page: `http://math.iit.edu/~rellis/454F09/` **Assignments posted here, check often!**

Math 454 Prerequisites: Math 251 or Math 252
Math 553 Prerequisites: Math 453 or instructor's consent

Text: *Introduction to Graph Theory*, Doug West, 2nd edition, Prentice Hall
The textbook web resource `http://www.math.uiuc.edu/~west/igt/` has supplemental exercises, typos, and other information.

Description. This is a serious proofs-oriented introductory course about properties and applications of graphs. We will study many important and widely-used topics in graph theory, including paths and trees (with application to building roads or telephone lines at minimum cost), matchings (with application to assigning tasks to workers), connectivity and network flow (with application to transshipment), coloring and intersection graphs (with application to scheduling), planarity (important in facility location and VLSI/computer chip layout), and Hamiltonian cycles (used in the Traveling Salesman Problem. The particular applications considered may be influenced by the interests of the students.

Topics. We will attempt to cover all material of Chapters 1–7 of the text. If optional material or outside material is included along the way, other material will be omitted.

Dual-delivery Math 454 and Math 553. Students enrolled in both Math 454 and Math 553 will attend the same lectures. For those taking Math 553, the homework assignments and the exams will include more advanced material on the same topics.

Class Attendance. The text is excellent but it is extremely difficult to master the material therein without the regular guidance of the instructor. Developing good proof-writing skills is critical, and will be modeled in lecture. Attending every class is strongly expected. Absences are not penalized per se, except that they are virtually guaranteed to reduce your grades on exams and homeworks. The instructor reserves the right to allow make-up work only in the event of an IIT-approved event or emergency. One week's prior notice must be given for IIT-approved events.

Grade Breakdown. Course notebook (described below) Section 1: 5%. Course notebook Section 2: 5%. Homework 20%. Exam 1 20%. Exam 2 20%. Final exam: 30%. The instructor reserves the right to move up to 5% from Homework and 2.5% from each of Exam 1 and 2 in order to assign a final project worth up to 10%; this will be decided by November 1 based on progress made in the course.

Student Deliverables for Grade.

A. Notebook of major concepts, examples and counterexamples, and concept maps. Each student shall maintain a notebook for the course containing two sections, kept separate from other material, and with the same order as the material of the textbook. The two sections shall be legible and kept separate from each other and from any other notes. A loose-leaf notebook with separators is recommended; those who insist on using spiral-bound notebooks or otherwise poor organization will not receive exceptions for illegible or unorganized work. An electronic notebook may be kept provided it is in a form that is easy for the instructor to read, such as a single PDF file.

Section 1 shall contain, for each subsection of the text that we cover:

- A list of all major concepts, such as definitions and theorems; and

- Whenever reasonable, an example and a counterexample of the concept, which should be as simple as possible while still conveying meaning. If identification of an example or a counterexample is not reasonably possible to produce, for example if it requires a nontrivial theorem, the reason must be clearly stated.

For all lectures except the first, every student is required to have completed the notebook entry before the lecture in which the material is covered. Valuable lecture time will therefore be spent examining the more complex relationships between definitions and theorems, and on investigating algorithms and modeling good proof techniques. At least one entry for Section 1 will be modeled by the instructor in the first week. Section 1 will be graded equally on comprehensibility/organization, and on correctness of examples and counterexamples. The penalty for illegibility or incompleteness will be proportionate to the amount of material affected.

Section 2 shall contain at least one concept map (see `http://en.wikipedia.org/wiki/Concept_map`) for each subsection (four for Chapter 1, three for Chapter 2, etc.). You may choose any meaningful principle concept and focus question for your concept map, but are strongly advised to choose something you partially understand but need more practice with. At least one concept map will be modeled by the instructor in the first week.

- **Math 454 Enrollees** may optionally choose to create as many additional concept maps as are helpful in mastering the course.
- **Math 553 Enrollees** are required to make four of their concept maps available to the entire class, on a rotating basis spread throughout the semester. The format can be a PDF scan of very neat handwriting, a PDF file of a computer-assisted drawing, or in the format provided by the concept map software tool available for free at `http://cmap.ihmc.us/conceptmap.html` for Windows, Macintosh, and Unix platforms.

The concept maps in Section 2 will be graded equally on relevance of the principle concept and focus question to the course material, relevance and appropriateness of the concepts present in the map, and validity and appropriateness of the relationships represented in the links between concepts. The penalty for illegibility or incompleteness will be proportionate to the amount of material affected.

Notebook assessment and evaluation (grading). The notebook will be turned in at the final exam to be **graded** as part of the final course grade; this is an evaluation of the notebook according to the criteria previously described. Students may choose to submit their notebooks on a rolling basis up to four times in the semester to be **assessed**. No grade will be recorded for assessments. The instructor will identify strengths and weaknesses of the notebook against the criteria, and comment on any insights into the students' progress in understanding the material of the course. This option should be used by students who are committed to using the feedback to improve their notebooks and their general performance in the class regardless of the current level of performance.

B. Homework. Homework will serve to improve students' clarity of thought and language when writing or communicating mathematics. Homework assignments will be made roughly weekly, and posted at least one week in advance on the course homepage. 80% of the homework score will be on mathematical correctness, and 20% will be on clarity of presentation. Correctness means including all major steps required for the solution, making a valid argument, and solving the problem given. A list of equations with no accompanying explanation is not a fully correct solution. Clarity of presentation includes conciseness and a readable flow of solution with steps in a good order. The penalty for illegibility, incompleteness, or working the wrong problem will be no credit for all affected work. Write solutions so that a fellow student can understand. Homework assignments will be differentiated in difficulty for those enrolled in Math 454 versus those in Math 553. The instructor reserves the right to require homeworks to be done in groups of 2-3.

C. Exams and Final Exam. Exams will consist of three parts: I. Examples, Counterexamples, and Short Answer; II. Algorithms and Computation; and III. Proofs. For those enrolled in Math 454, The approximate distribution of points and level of difficulty over these sections is given by links to prior exams on the course webpage. Those enrolled in Math 553 must expect an increase in difficulty analogous to the homework.

Homework collaboration. You are encouraged to discuss homework problems and the content of Sections 1 and 2 of the notebook, but **only** with another student in **this** class, the TA, or the instructor. When you **write up** the solution, however, **you must not consult any notes or other aids from these discussions**. Then

you may only use the textbook unless otherwise instructed. For example, if you start to write the solution, get stuck, and consult someone half-way, you must start the solution over without referring to the first attempt. Use your common sense to extrapolate from these guidelines or contact the instructor regarding uncertainties. You are recommended not to violate this policy both because of possible prosecution and because of the resulting ill-preparedness for exams.

Plagiarism. Broadly speaking, plagiarism is claiming someone else's work as your own. Examples of plagiarism include (i) copying material from Wikipedia to solve a homework problem, (ii) referring to another student's solution while writing a solution to a homework problem, (iii) using solutions from a previous semester or external source while writing a solution to a homework problem, and (iv) asking another student to write your notebook entry or design a concept map. These examples are by no means exhaustive. Upon discovering plagiarism, the instructor reserves the right to assign a zero grade for the entire assignment, and depending on severity may choose to prosecute the case within IIT for a zero grade in the course.

Academic Honesty. Except where collaboration is allowable as described above for homework and the notebook, all work must be the student's own. This especially pertains to taking exams, without any aids other than allowed by the exam rules. Exam rules will, unless otherwise announced, allow only a pen or pencil. The Code of Conduct and applicable penalties in the IIT Student Handbook apply.

Copyright. Section 1 of the notebook is by nature **not original work**, except perhaps for particularly special examples, counterexamples, or other observations made. Therefore Section 1 should be for the personal academic use by the student only and not disseminated to other students, other persons, or through any transmissible media, due to the copyright of the text. Section 2 of the notebook may or may note contain original concept maps. Other material of the course should be considered carefully in the context of existing copyright.

Missed Work. Assignments and exams cannot be made up except as approved by the instructor, due to official IIT activity or documented emergency. Notification of absence for an official IIT activity must be one week in advance. An exam missed for an excused reason must be made up promptly upon the student's return, the time frame being at the discretion of the instructor.

Disability Assistance. IIT and this instructor are committed to accommodating students with disabilities. Students desiring such consideration must immediately contact the Center for Disability Resources and Educational Development at 567-5744. The instructor must receive documentation for any accommodation for taking exams at least two weeks in advance.