Marshall University
Syllabus

Course Title/Number	**Math 635: Graph Theory and Combinatorics**
Semester/Year	Spring 2014
Days/Time	Tuesday and Thursday 9:30am-10:45am
Location	Smith Hall 511 (subject to change)
Instructor	Carl Mummert
Office	Smith Hall 742E
Phone	(304) 696-6156
E-Mail	mummertc@marshall.edu
Office/Hours	Monday, Wednesday, Thursday 3:00pm-4:00pm; Tuesday 3:00pm-5:00pm
University Policies	By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy be going to www.marshall.edu/academic-affairs and clicking on "Marshall University Policies." Or, you can access the policies directly by going to http://www.marshall.edu/academic-affairs/?page_id=802 Academic Dishonesty/ Excused Absence Policy for Undergraduates/ Computing Services Acceptable Use/ Inclement Weather/ Dead Week/ Students with Disabilities/ Academic Forgiveness/ Academic Probation and Suspension/ Academic Rights and Responsibilities of Students/ Affirmative Action/ Sexual Harassment

Course Description: From Catalog

This course is designed to introduce students in mathematical sciences to the theorems, techniques, and applications of graph theory and combinatorics. 3 credit hours.

The table below shows the following relationships: How each student learning outcomes will be practiced and assessed in the course.

Student Learning Outcomes	**How students will practice each outcome**	**How student achievement of each outcome will be assessed**
Students will be able to recall and state precisely the definitions of the fundamental concepts of graph theory.	Discussions, group work, board work, homework	Quizzes and exams
Students will be able to recall key theorems of graph theory, including their hypotheses, and state theorems precisely when given their names.	Discussions, group work, board work, homework	Quizzes and exams
Students will be able to solve standard combinatorial problems using a variety of combinatorial techniques.	Discussions, group work, board work, homework	Quizzes and exams
Students will be able to recall and explain examples, compare them with each other, and apply them to produce counterexamples.	Discussions, group work, board work, homework	Quizzes and exams
Students will be able to write proofs to	Discussions, group work,	Quizzes and exams

verify the correctness of propositions related to the course material.	board work, homework	
Students proofs will show a level of mathematical correctness and precision appropriate for a graduate mathematics major.	Discussions, group work, board work, homework	Quizzes and exams

Required Texts, Additional Reading, and Other Materials

1. *How to Count*, by R.B.J.T. Allenby and Alan Slomson, 2nd edition, ISBN 978-1-4200-8260-9. During the course, we will discuss most of chapters 1, 2, 3, 4, 5, 7, 8, 9, and 10 from the textbook.

Course Requirements / Due Dates

1. Daily homework
2. Quizzes most days of class.
3. Two take-home exams. Dates will be announced at least one week in advance.
4. Two additional graduate assignments.
5. Final exam.

Grading Policy

- Quizzes: 15%
- Homework: 10%
- Take-home exams: 40%
- Graduate assignments: 15%
- Final exam: 35%
- The course will use a 90/80/70/60 grading scale

Attendance Policy

I expect you to attend every class meeting. There will be no make-up quizzes. If you have an excused absence, any daily quizzes that you miss will be waived. Make-up exams will be given only when there is an excused absence.

Course Material

During the course, we will discuss most of chapters 1, 2, 3, 4, 5, 7, 8, 9, and 10 from the textbook.

Math 635.201 Spring 2014 CRN 4701

Graph Theory and Combinatorics

Dr. Carl Mummert

December 30, 2013

Marshall University

What is this course about?

Math 635 is a graduate-level proof-based course in combinatorics and graph theory.

Combinatorics

Combinatorics is the study of the patterns formed when objects are put into fixed configurations. For example, there are 6 ways that three letters A, B, C can be arranged in a sequence – these are the "permutations" of the set $\{A, B, C\}$. Combinatorics includes both the problem of *counting* the possible arrangements (there are 6 of them) and *enumerating* all possible arrangements (they are ABC, ACB, BAC, BCA, CAB, and CBA).

Combinatorics is special among mathematical disciplines because it includes an enormous variety of problems linked only by their ability to be solved by similar combinatorial techniques. Researchers in all areas of mathematics use techniques from combinatorics to solve their own subject-specific problems.

You will learn a collection of key combinatorial techniques in this course: permutation and combination numbers, Stirling numbers, the inclusion/exclusion method, recurrence relations, generating functions, and more. You will also learn to verify your answers by producing sound proofs, often using mathematical induction.

Much of my own research is combinatorial, and I hope to be able to give you a few examples during the semester. Dr. Niese and Dr. Jung also study combinatorics in their research.

Graph theory

Graphs are used to model connections between objects. Graph theory is used to study maps, road and train networks, wiring inside computers, and other applied problems. It is also used to study mathematical objects such as knots and topological spaces.

In this course, you will learn fundamental definitions and theorems of graph theory. You will also learn fundamental algorithms, such as algorithms for tree traversals and for finding spanning subtrees of graphs.

Dr. Schroeder studies graph theory and combinatorics in his research.

Course details

Course catalog description

This course is designed to introduce students in mathematical sciences to the theorems, techniques, and applications of graph theory and combinatorics

Textbook

How to Count, by R.B.J.T. Allenby and Alan Slomson, 2nd edition, ISBN 978-1-4200-8260-9

During the course, we will discuss most of chapters 1, 2, 3, 4, 5, 7, 8, 9, and 10 from the textbook.

Schedule

Class meetings will be in Smith Hall 511 from 9:30pm to 10:45am, Tuesday and Thursday.

Calculators and Technology

You do not need a calculator for this course, and you will not be permitted to use a calculator on in-class assignments or examinations. I will show you how to use Mathematica to compute the exact values of combinatorial expressions, but you will not be tested on this.

I will post handouts and announcements on MU Online. You should check there often for updates. You will also require access to your Marshall email account for course communications.

Course goals - what will you learn?

At the end of this course:

1. You will be able to recall and state precisely the definitions of the fundamental concepts of graph theory.
2. You will be able to recall key theorems of graph theory, including their hypotheses, and state theorems precisely when given their names.
3. You will be able to solve standard combinatorial problems using a variety of combinatorial techniques.
4. You will be able to recall and explain examples, compare them with each other, and apply them to produce counterexamples.
5. You will be able to write proofs to verify the correctness of propositions related to the course material.
6. Your proofs will show a level of mathematical correctness and precision appropriate for an graduate-level mathematics student.

About the professor

Dr. Carl Mummert
Office: Smith Hall 742E
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E-mail: mummertc@marshall.edu

Office hours

I am in my office most of the time, and you are welcome to come any time I am there. My weekly schedule is posted on my door. My cell phone number is also posted on my door, to help locate me during working hours or to contact me (in urgent situations) at other times.

The following times are my "scheduled office hours":

Monday, Wednesday, Thursday	3:00pm – 4:00pm
Tuesday	3:00pm – 5:00pm

Assignments – what do you have to do?

Homework

As we proceed through the book, when we begin a new section I will announce when you are "*responsible*" for that section. Your homework for each section is to complete the following tasks before the date when you are responsible for the section:

1. Study the worked "problems" in the section and be able to solve them again from memory on a quiz or exam.
2. Solve all the "exercises" in the section and be able to solve them again on a quiz or exam. The book has two kinds of exercises, labeled "A" and "B". Complete solutions to the "A" exercises are given at the end of the textbook. I will distribute summary answers to the "B" exercises to help you check you work.
3. Study the theorems and proofs of the section. Be able to state all named theorems, and be able to prove from memory all theorems that are proved in the textbook.

You will be required to write solutions to all "B" exercises from each section for which you are responsible, and submit them on the day that you are responsible for the section. These solutions must be clear and explanatory, and written in prose. Because I will distribute summary solutions to the "B" exercise, the goal of your solutions is to explain *how* to solve the problem, not merely provide a numerical value.

Graded assignments

There are five kinds of graded assignments in this course:

- *Daily quizzes* (15% of grade): There will be 10-minute quizzes at the beginning of class most days. These will include problems that relate to the sections of the textbook for which you are responsible.
- *Homework* (10% of grade): You are required to write solutions to the "B" exercises in the textbook.
- *Graduate assignments* (15% of grade): you will complete two additional individual assignments, as explained below. Together, these are worth 15% of your grade.
- *Take-home exams* (40% of grade): There are two take-home exams during the semester. The date for each exam will be announced at least one week in advance.
- *Final oral exam* (30% of grade). This will be a comprehensive oral exam on material from the entire course. You will schedule a 60-minute appointment with me to take the exam. I will distribute additional information on the exam during the semester.

Grading scale

Your grade in the course will be assigned on the following scale:

A: 90% – 100%	B: 80% – 90%	C: 70% – 80%	D: 60% – 70%

Graduate assignments

You can pick any two of the following assignments. In some cases, you can do two assignments of the same kind, by choosing different chapters or sections, or by choosing different programming assignments.

1. Read one of the following chapters independently and write complete solutions to all the "B" problems: Chapter 6, 8, 12, or 15. We will not discuss these chapters during class, but I can discuss them with you during office hours.

2. Complete a programming assignment. I will have two programming assignments, one for combinatorics and one for graph theory. Each of these will require writing several computer programs to implement algorithms related to the course material. One of the assignments will be due at the middle of the semester, and the other will be due on the last day of class.

3. Present a section of the textbook to the class. To complete this assignment, you must contact me ahead of time to be assigned a section; you must rehearse your presentation during my office hours at least one week in advance, until I am convinced you are prepared; and then you must lead the class for one session, presenting the material from the section that you have been assigned.

Course policies

For a complete list of the university policies that apply to this class, please see the undergraduate handbook at the following URL:

http://www.marshall.edu/wpmu/academic-affairs/policies/

In particular, this course includes the following university policies: Academic Dishonesty, Excused Absences, University Computing Services Acceptable Use, Inclement Weather, Dead Week, Students with Disabilities, Academic Dismissal, Academic Forgiveness, Academic Probation and Suspension, Affirmative Action, Sexual Harassment.

Anti-plagiarism policy

Plagiarism of any kind is not permitted. Students who plagiarize on an assignment will receive a zero for that assignment, and the university-wide plagiarism policy will be followed. I will give you detailed information on what is considered plagiarism in this class.

Attendance policy

I expect you to attend every class meeting. There will be no make-up quizzes. If you have an excused absence, any daily quizzes that you miss will be waived. Make-up exams will be given only when there is an excused absence.

Excused absences

I will excuse any absences that are covered by the university's excused absence policy, including:

1. *University-sponsored activities*: performing arts, debate and individual events, honors classes, ROTC, and departmental functions, etc. You must secure an excuse from the Dean of Students, Dr. Steve Hensley, in the MSC.
2. *Athletics*: official athletic events sponsored by the Athletic Department. Your coach will give you a letter to give to your instructors.
3. *Other university activities*: student government, student organizations, etc. The organization's sponsor will will give you a letter to give to your instructors.
4. *Short-term military obligation.* You must present your orders to the Dean of Students, Dr. Steve Hensley, in the MSC.
5. *Jury duty or subpoena.* You must secure an excuse from the Dean of Students, Dr. Steve Hensley, in the MSC.
6. *Religious holidays.* You must secure an excuse from the Dean of Students, Dr. Steve Hensley, in the MSC.

For other types of absences, I will decide on a case by case basis. Travel plans and work obligations can make it difficult to attend class, but they do not qualify as excused absences.