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| **MATH 231: Elements of Discrete Mathematics** |

**Place and time: MWF 9:00 am to 9:50 am, room GLSN 200.**   
  
**Course Content:**

* Basic logic, including quantifiers and De Morgan's Laws for negations.
* Direct proof techniques.
* Indirect proof techniques of contradiction and contraposition.
* Elementary set theory and functions.
* Mathematical induction and recursion.
* Elementary combinatorics, including the Sum and Product Rules, permutations, combinations.
* Basic graph theory, including connectedness.
* Algorithm for either shortest-path routing (or minimal spanning trees), including a proof of the correctness.

**Measurable Student Learning Outcomes:** A successful student in MTH 231 will be able to:

* Apply basic set operations.
* Be able to negate compound and quantified statements and form contrapositives.
* Be able to construct a direct proof (from definitions) of simple statements.
* Learn and apply the Principle of Mathematical Induction.
* Demonstrate an understanding of the construction of indirect proofs by contraposition and contradiction.
* Construct complete explanations for solutions to counting problems.
* Be able to use at least one algorithm for finding a shortest path or a minimal spanning tree in a connected graph.

**Textbook:** Kenneth Rosen, *Discrete Mathematics and its Applications,* Seventh Edition   
  
**Timeline:**   
  
1. Logic (Sections 1.1 to 1.5) covered in lectures 1-4   
  
2. Proof techniques and strategies (Sections 1.7 to 1.8) covered in lectures 5-7   
  
3. Sets and functions (Sections 2.1 to 2.3) covered in lectures 8-10   
  
4. Mathematical induction and recursion (Sections 5.1 to 5.3) covered in lectures 11-14   
  
5. Basic counting (Sections 6.1, 6.3, 6.4) covered in lectures 15-18   
  
6. Graph theory (Sections 10.1 to 10.7) covered in lectures 19-26   
  
  
**Homework:** The assignments will be collected at the beginning of recitation on Tuesdays. **Late homework will not be accepted.**   
  
**Homework #1 (due Tuesday, October 13):** Sec. 1.1 #33;  Sec. 1.2 #16, 24;   Sec. 1.3 #8, 25;   Sec. 1.4 #6, 14;   Sec. 1.5 #9, 24   
  
**Homework #2 (due Tuesday, October 20):** Sec. 1.7 #4, 11, 22;  Sec. 1.8 #4, 8;   Sec. 2.1 #1, 7   
  
**Homework #3 (due Tuesday, October 27):** Sec. 2.1 #6, 12, 16, 42;   Sec. 2.2 #19, 27, 29   
  
**Homework #4 (due Tuesday, November 3):** Sec. 2.3 #6(a,b,d), 10, 16, 20;   Sec. 5.1 #3, 15   
  
**Homework #5 (due Tuesday, November 10):** Sec. 6.1 #5, 22, 37, 40;   Sec. 6.3 #13, 18, 27   
  
**Homework #6 (due Tuesday, November 17):** Sec. 6.3 #26, 31, 38;   Sec. 6.4 #6, 7, 22   
  
**Homework #7 (due Tuesday, November 24):** Sec. 10.2 #2, 28, 30;   Sec. 10.5 #10, 13, 37, 43   
  
**Homework #8 (due Tuesday, December 1):** Sec. 10.3 #13, 16, 35, 41;   Sec. 10.7 #5, 12, 14   
  
**Midterms:** There will be two midterm exams.  
**Midterm 1** is scheduled for Wednesday, **October 28** in class. The midterm is closed books. However, an 8.5 by 11 inch sheet of notes is allowed with HANDWRITTEN notes on both sides. Calculators are allowed. Midterm 1 will test what we covered in the first four weeks of the quarter. Specifically, the material in sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, 5.1 that was covered in class.  
  
**Midterm 2** is scheduled for Wednesday, **November 18** in class. The midterm is closed books. However, an 8.5 by 11 inch sheet of notes is allowed with HANDWRITTEN notes on both sides. Calculators are allowed. Midterm 2 will cover the material in sections 1.7, 1.8, 5.1, 5.2, 6.1, 6.2, 6.3, 6.4.   
  
**Final Exam:** **Thursday, December 10th, 7:30 am - 9:20 am**. Location **DEAR 118**. The exam is open notes (but not open books).   
  
**Schedule:**   
***Friday, September 25***  Propositional Logic. Examples and applications. Sections 1.1 and 1.2. [Lecture 1 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture01.pdf)   
***Monday, September 28***  Propositional Logic. Examples and applications. Propositional equivalences. De Morgan's Laws for negations. Section 1.3. [Lecture 2 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture02.pdf)   
***Wednesday, September 30***  Logic puzzles. Predicates and quantifiers. Sections 1.2 and 1.4. [Lecture 3 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture03.pdf)   
***Friday, October 2***  Predicates and quantifiers. Nested quantifiers. De Morgan's laws for quantifiers. Sections 1.4 and 1.5. [Lecture 4 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture04.pdf)   
***Monday, October 5***  Methods of Proof. Sections 1.7 and 1.8. [Lecture 5 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture05.pdf)   
***Wednesday, October 7***  Methods of Proof. Sections 1.7 and 1.8. [Lecture 6 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture06.pdf)   
***Friday, October 9***  Methods of Proof. Introduction to set theory. Sections 1.7, 1.8, and 2.1. [Lecture 7 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture07.pdf)   
***Monday, October 12***  Introduction to set theory. Sections 2.1 and 2.2. [Lecture 8 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture08.pdf)   
***Wednesday, October 14***  Introduction to set theory. Sections 2.1 and 2.2. [Lecture 9 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture09.pdf)   
***Friday, October 16***  Functions. Section 2.3. [Lecture 10 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture10.pdf)   
***Monday, October 19***  Mathematical induction. Section 5.1. [Lecture 11 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture11.pdf)   
***Wednesday, October 21***  Mathematical induction. Strong induction. Sections 5.1 and 5.2. [Lecture 12 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture12.pdf)   
***Friday, October 23***  Strong induction. Section 5.2. [Lecture 13 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture13.pdf)   
***Monday, October 26***  Review.   
***Wednesday, October 28***  **Midterm 1**   
***Friday, October 30***  Counting principles. Permutations. Combinations. Sections 6.1 and 6.3. [Lecture 14 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture14.pdf)   
***Monday, November 2***  Counting principles. Permutations. Combinations. Sections 6.1 and 6.3. [Lecture 15 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture15.pdf)   
***Wednesday, November 4***  Combinations. Generalized combinations. The Binomial Theorem. Sections 6.3 and 6.4. [Lecture 16 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture16.pdf)   
***Friday, November 6***  Combinations. Generalized combinations. The Binomial Theorem. Examples. Sections 6.3 and 6.4. [Lecture 17 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture17.pdf)   
***Monday, November 9***  Introduction to graphs. Paths and cycles. Euler cycles. Sections 10.1, 10.2 and 10.5. [Lecture 18 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture18.pdf)   
***Friday, November 13***  Introduction to graphs. Paths and cycles. Euler cycles. Sections 10.2, 10.4, and 10.5. [Lecture 19 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture19.pdf)   
***Monday, November 16***  Paths and cycles. Euler cycles. Hamiltonian cycles. Sections 10.2, 10.4, and 10.5. [Lecture 20 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture20.pdf)   
***Wednesday, November 18***  **Midterm 2**   
***Friday, November 20***  Hamiltonian cycles. Dijkstra's shortest-path algorithm. Adjacency matrix. Sections 10.3, 10.5, and 10.6. [Lecture 21 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture21.pdf)   
***Monday, November 23***  Adjacency matrix. Isomorphisms of graphs. Section 10.3. [Lecture 22 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture22.pdf)   
***Wednesday, November 25***  Isomorphisms of graphs. Planar graphs. Euler's Formula. Sections 10.3 and 10.7. [Lecture 23 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture23.pdf)   
***Monday, November 30***  Planar graphs. Euler's Formula. Sections 10.3 and 10.7. [Lecture 24 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture24.pdf)   
***Wednesday, December 2***  Planar graphs. Euler's Formula. Introduction to trees. Spanning trees. Sections 10.7, 11.1, and 11.4. [Lecture 25 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture25.pdf)   
***Friday, December 4***  Introduction to trees. Spanning trees. Review. Sections 11.1 and 11.4. [Lecture 26 slides (PDF)](http://math.oregonstate.edu/~kovchegy/math231fall2015/231_lecture26.pdf) 