Math 203
Plans for Chapter 1
Street Networks

Chapter Objectives: Understand the basic terminology of graphs (edge, vertex, valence, connected). Learn about Euler circuits, what kinds of problems they are used for, when they exist in a graph, and how to find them when they do exist.

- Assignment already made:
  - **Reading:** Pages 0-10
  - **Reading Homework:** Chapter 1, #14.

Day 1:
0. Always begin class by collecting reading homework. You might also want to begin the first few class periods by taking roll, to help you learn names.
1. Have the students give you the definitions on page 4 (graph, vertices, edges, path, circuit); also ask for the definition of valence. Set the stage for the rest of the semester by insisting that the students tell you these definitions – they should know them from their reading which was to be done for today.
2. Have students work on sheet M1a, and compare their results in small groups. Have a brief discussion on the questions at the bottom of the page.
3. Discuss the definition of Euler circuit and the statement of Euler’s Theorem.
4. If time allows, discuss problem 13 in class. In addition to drawing the graph, you should discuss whether or not an Euler circuit is possible, and how that relates to the set-up of the problem. (If there is not time to do this problem, you may wish to assign it.)
5. **Homework Problems:** Chapter 1, #1, 2, 9, 11, 12 (and 13 if you didn’t do it in class.)
   - **Reading:** Pages 10-15 (stop at “A better Eulerization”)
   - **Reading Homework:** Chapter 1, #18

Day 2:
1. Go over homework. (Put problem numbers (just the numbers) 2a, 2b, 12a, and 12b on the board, spaced out. Ask for volunteers to put the solutions on the board – make sure someone does it, ideally before class even starts. Ask if there are questions on these or any of the odd-numbered problems.)
2. Discuss the meaning of Euler’s theorem and give the idea of the proof. Emphasize the meaning of the word theorem and the phrase “if and only if”.
3. Work on problem 33, either as a class or in groups. For the ones with no Euler circuit possible, have students try for a good Eulerization. Discuss the fact that, in Eulerizing a graph which represents a real-world situation, you want to be sure to **duplicate** existing edges rather than **create** new ones. (Otherwise you might be plowing down someone’s house!)
4. Work on problem 36 as a class to explain how a circuit on an Eulerized graph translates into a circuit on the original graph.
5. **Homework Problems:** Chapter 1, #20, 32, 42.
   - **Reading:** Pages 15-20.
   - **Reading Homework:** Chapter 1, #26.

Day 3:
1. Go over homework, including #26. This could take awhile.
2. Look at examples of ”good Eulerizations” in the text for rectangular networks (pp. 16-17) and do the 5 x 6 case on the board.
3. Have the students work on the 4 x 6 case.
4. If you have time, here’s a great topic for a “modeling” discussion. Draw the city of Königsberg on the board (land north and south and two islands in a river; for the west island have two bridges going to the north shore and two to the south shore; for the east island have one bridge north and one south; also have a bridge connecting the two islands). Tell the students the story (common pastime in the city of Königsberg was to try to go for a walk around the city, starting and ending in the same place and crossing every bridge exactly once). Have each student draw what they think is the proper graph for the problem. (The correct solution has 7 edges and 4 vertices.) Have as many students as possible put their (different) solutions on the board – hopefully someone will get the right answer. Label each solution and have the students try to figure out which one is right and convince their neighbors. (Peer Instruction!) This activity could take awhile, but it’s definitely worth it.
5. **Homework Problems:** Chapter 1, #22, 25, 27, 28. (On #28, does it matter where A is?) Note: #28 is a variant of the famous Königsberg Bridge problem, not mentioned in the text.
   - **Reading:** Pages 31-43 (This is Chapter 2!)
   - **Reading Homework:** Chapter 2, #12.