MATH 335 Graph Theory

1. Catalog Description

MATH 335 Graph Theory **4 units**

Prerequisite: MATH 248 or junior standing.

Introduction to graph theory and its applications: isomorphism, paths and searching, connectedness, trees, tournaments, planarity, graph colorings, matching theory, network flow, adjacency and incidence matrices. Further topics to be selected from the theory of finite state machines, Ramsey theory, extremal theory, and graphical enumeration. 4 lectures.

2. Required Background or Experience

MATH 248 or Junior standing.

3. Learning Objectives

The student should gain an understanding of the fundamental concepts of graph theory.

4. Text and References

To be chosen by instructor. Suggested texts include:

- Buckley, Fred and Marty Lewinter, A Friendly Introduction to Graph Theory
- Chartrand, G. and Linda Lesniak, Graphs and Digraphs
- West, Douglas B., Introduction to Graph Theory
- Wilson, Robin J., Introduction to Graph Theory

References:

- Balakrishnan, V. K., Schaum's Outline of Graph Theory
- Cameron, Peter J., Combinatorics
- Grimaldi, Ralph P., Discrete and Combinatorial Mathematics
- Harary, Frank, Graph Theory

5. Minimum Student Materials

Paper, pencils, and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space for class use.

7. Content and Method

a. **Introduction**
Graphs and digraphs as models

b. **Isomorphism**

c. **Paths**
Eulerian and Hamiltonian paths with applications to the postman and traveling salesman problems, determination of shortest and longest paths, scheduling, use of matrices to find the number of paths of a given length.

d. **Connectivity**
Edge and vertex connectivity, cutpoints, bridges, and blocks.

e. **Trees**
Kruskal's minimal spanning tree algorithm, rooted search trees, tree enumeration.

f. **Planarity**
Planar graphs, Euler's formula, testing for planarity, duality, planarity on general surfaces.

g. **Graph Coloring**
Edge and vertex colorings, chromatic polynomials, the Four-Color Theorem, graph embeddings and the Heawood Map-Coloring Theorem.

h. **Network Flow and Connections with the Matching Theorem**
Optimal flow algorithm and the theorems of Menger, Konig, and Hall.

i. **Further Topics Selected by Instructor**

8. Methods of Assessment

Comprehensive final exam, mid-term exams or quizzes, homework.