Prefix, Number and Name of Course: MAT 270 Discrete Mathematics

Credit Hours: 3
In Class Instructional Hours: 3 **Labs:** 0 **Field Work:** 0

Catalog Description:
Prerequisite: 4 years of high school mathematics or equivalent. Fundamental principles used in discrete mathematics. Topics include logic, mathematical induction, sets, relations, functions, permutations, combinations, recursion, and graph theory.

Reasons for Revision:
The current MAT 270 is being revised because it no longer requires a strong emphasis on the techniques of mathematical proof, as this is now covered in our new course MAT 300. The revision also puts a greater emphasis on counting techniques and graph theory, concepts that are applicable to both pure and applied mathematics. Furthermore, the changes to the prerequisites will make Discrete Mathematics a potential IF course. This revision also responds to the recommendations given in the *Mathematical Education of Teachers* (MET), a report published by the Mathematical Association of America in 2001. This report is addressed to programs involved in the education of mathematics teachers and recommends that such programs offer courses that cover mathematical reasoning, combinatorial analysis, and discrete structures. More specifically, the MET states that prospective secondary mathematics teachers should be exposed to graphs, trees, finite difference equations, iteration and recursion.

Student Learning Outcomes Students will:	**Content References**	**Assessment**
1. Express English statements in formal logic and identify statements that are logically equivalent.	I	Exam/homework problems that evaluate an understanding of logic.
2. Demonstrate a working knowledge of set notation and elementary set theory, recognize the connections between set operations and logic; prove elementary results involving sets.	I	Exam/homework problems that measure an understanding of set theory.
3. Determine when a relation is reflexive, symmetric, or transitive. Explain the connection between equivalence relations and set partitions.	I	Exam/homework problems that appraise the ability to interpret relations.
4. Apply basic counting principles including the pigeonhole principle and rules for counting permutations and combinations.	II	Exam/homework problems that assess an understanding of counting principles.
5. Solve recurrence relations, including problems that arise from compounding interest and amortization.	III	Exam/homework problems that verify an ability to solve recurrences.
6. Construct elementary proofs using induction to establish the validity of properties concerning counting, recursion, relations, and graph theory.	I-IV	Written reports, exams and homework appraising proof writing skills.
7. Explain basic definitions and properties associated with simple planar graphs, including isomorphism, connectivity, and Euler's formula.	IV	Written reports, exams and homework that assess knowledge of graph theory.

Course Content:

I. FUNDAMENTALS

A. Logic
B. Propositional Equivalence
C. Predicates and Quantifiers
D. Sets and Set Operations
E. Functions
F. Relations
G. Sequences and Summations
H. Mathematical Induction

II. COUNTING

A. Product and Sum Rules
B. Permutations and Combinations
C. Pigeon Hole Principle
D. Binomial Coefficients
E. Inclusion-Exclusion
F. Probability

III. RECURSION

A. Recursively Defined Sequences
B. Recurrence Relations
C. Solving Recurrence Relations
D. Applications

IV. GRAPHS AND TREES

A. Graphs: Definitions and Examples
B. Euler Characteristic of Planer Graphs
C. Paths and Circuits
D. Representing Graphs
E. Trees: Definitions and Examples
F. Breadth-first Search and Depth-first Search (optional)
G. Applications

Resources:

Scholarship:

Bona, *A Walk Through Combinatorics: An Introduction to Enumeration and Graph Theory,* 3rd edition, *World* Scientific Publishing Company, 2011.

Cunningham, Daniel W., *A Logical Introduction to Proof*, Springer, 2012.

Devlin, *Sets, Functions, and Logic: An introduction to Abstract Mathematics, 3rd edition,* Chapman Hall, 2003.

Dossey, Otto, Spence, Vanden Eynden, *Discrete Mathematics,* 5th edition, Pearson, 2006.

Epp, *Discrete Mathematics with Applications*, 4th edition, Brooks Cole, 2010.

Harris, Hirst, Mossinghoff, *Combinatorics and Graph Theory,* 2nd edition, Springer, 2008.

Johnsonbaugh, *Discrete Mathematics,* 7th edition, Prentice Hall, 2008.

Liebeck, *A Concise Introduction to Pure Mathematics,* 3rd edition, CRC press, 2010.

Lovasz, Pelikan, Vesztergombi, *Discrete Mathematics,* Springer, 2003.

Richmand, Richmand, *A Discrete Transition to Advanced Mathematics*, AMS, 2004.

Rosen, *Discrete Mathematics and Its Applications,* 6th edition, McGraw-Hill, 2006.

Periodicals:

American Mathematics Monthly
College Mathematics Journal
Journal of Mathematical Modeling and Algorithms
Math Horizons

Electronic and/or Audiovisual Resources:

http://www.maa.org/cupm/ill_ref/part2/C.html *Students majoring in the mathematical sciences,* Committee on the Undergraduate Program in Mathematics.

http://www.maa.org/saum/ Supporting Assessment in Undergraduate Mathematics.

http://www.gfredericks.com/sandbox/graphs A searchable database of small connected graphs.

http://www.babelgraph.org/links.html Concise, annotated list of graph theory resources.

http://en.wikipedia.org/wiki/List_of_puzzle_topics List of combinatorial puzzles.

http://vihart.com/doodling/binary-trees/ Video illustrating exponential growth in binary trees.

http://vihart.com/doodling/ Snakes & graphs. Video with some interesting student-accessible graph theoretic/combinatorial questions.