

## **MATH 530 Discrete Mathematics with Applications I**

### 1. Catalog Description

#### **MATH 530 Discrete Mathematics with Applications I (4)**

Methods of discrete mathematics with applications. Generating functions and Lagrange inversion, partition theory, permutation statistics and q-analogues, posets and Möbius inversion. Additional topics including lattice paths and basic hypergeometric series. 4 lectures. Not open to students with credit in MATH 435. Prerequisite: MATH 248 with a grade of C- or better and MATH 336 and graduate standing or consent of the instructor.

### 2. Required Background or Experience

Prerequisite: MATH 248 with a grade of C- or better and MATH 336, or consent of instructor.

### 3. Learning Objectives

Upon completion of MATH 435, a student will be able to:

1. Use generating functions to investigate the properties of integer sequences and to solve counting problems.
2. Understand integer partitions and become familiar with classical results in the area
3. Learn how to examine permutations by rises, descents, inversions, and the major index.
4. Extend their basic knowledge of inclusion/exclusion gained in MATH 336 by examining partially ordered sets and Möbius inversion.
5. Understand and apply the standard techniques of discrete mathematics to solve problems from probability theory, combinatorics, and number theory.

### 4. Text and References

Text to be specified by instructor.

References:

- Graham, Ronald, Concrete Mathematics, 2nd ed., Addison Wesley, (1994).  
Hardy, G. H. and E. M. Wright, An Introduction to the Theory of Numbers, 6th ed., Oxford University Press, (2008).  
J.H. Van Lint and R.M. Wilson, A course in Combinatorics, Cambridge Univ. Press (1993)  
R. Stanley, Enumerative Combinatorics Vol. I and II, Cambridge Univ. Press (2000)  
I. P. Goulden and D.M. Jackson, Combinatorial Enumeration, Dover (2004)  
G. E. Andrews. The Theory of Partitions, Cambridge Univ. Press (1998)

### 5. Minimum Student Materials

Paper, pencils and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space for class use.

7. ContentLectures

1. Generating functions, Lagrange inversion, the exponential formula.	5
2. Partition theory, Euler's pentagonal number theorem, the Jacobi triple product, Rogers-Ramanujan type identities	10
3. Permutation statistics, Gaussian numbers, and q-analogues	5
4. Posets and Möbius inversion, generalized inclusion/exclusion	10
5. Lattice paths and /or hypergeometric series and/or other advanced topics as selected by instructor (time Permitting)	6

Total	36
-------	----

Note:

The topics covered in MATH 435 are identical to those covered in MATH 530. MATH 530 is the graduate level version of MATH 435, and requires additional work for the graduate students enrolled in the course. Students in MATH 530 will be responsible for supplementary exercises and additional readings, and a presentation or project on the additional readings. Students will be prohibited from taking both MATH 435 and MATH 530.

8. Methods of Assessment

The primary methods of assessment are, in decreasing order of importance: essay examinations and homework. Typically, there will be two or three hour-long examinations during the quarter, and a comprehensive final examination. Students are required to show their work, and are graded not only on the correctness of their answers, but also on their understanding of the concepts and techniques. Regular homework is required. These assessment methods are used for each of the learning outcomes above.