# MATH 2113 / CSCI 2113
# Winter / Spring 2007
# List of Topics Covered

Note: This list is intended only as an aid to your studying for the final exam, and is neither a complete nor exhaustive list of examinable topics. Any topic covered in class or in the homework that is not listed here is also examinable. When in doubt, refer to your lecture notes.

- Enumerative Combinatorics
  - Basic counting arguments
  - Arrangements and selections
    - Arrangements around a circle
    - Distinguishable and identical objects
    - Poker hands, probability, and expected value
  - Counting recursively
    - Derangements, ballot lists, Catalan and Stirling numbers
  - Generating functions
    - Ordinary generating functions: basic concepts
    - Solving recurrence relations
    - Convolutions and proving identities
    - Counting with generating functions
- Functions and the Pigeonhole Principle
  - One-to-one and onto functions
  - Compression and codes
    - Hash functions
    - Huffman compression and prefix codes
  - The pigeonhole principle
    - Different forms of the pigeonhole principle: at most the average and at least the average
    - Applications to various problems
- Graph Theory
  - Concepts and definitions, elementary theorems
    - Degree-sum formula
    - Complements and complete graphs
    - Graph isomorphisms and graph invariants
  - Walks, paths, cycles, and circuits
    - Basic definitions

    * Eulerian circuits
    * Single-source shortest paths: Breadth First Search and Dijkstra's Algorithm
- Connectivity
    * Definitions: connectivity and connectedness
    * Necessary and sufficient conditions for the existence of Hamiltonian Cycles
    * Reduction of Hamiltonian Cycle to Travelling Salesman
- Bipartite graphs
    * Characterization of bipartite graphs
    * Matchings and Hall's Theorem
    * Related concepts: vertex cover, edge cover.
- Trees
    * Basic definitions
    * Characterizations of trees
    * Binary trees and rooted trees
    * Cayley's formula
    * Minimum weight spanning trees: Kruskal's Algorithm and Prim's Algorithm