Course Outline for
CSE 4833/6833, Introduction to Analysis of Algorithms

Textbook:
Introduction to Algorithms, Second Edition by Cormen, Leiserson, Rivest, and Stein. The MIT Press, McGraw-Hill Book Company, 2001.

Course Outline:

I. Analyzing & designing algorithms
- A. The Role of Algorithms in Computing
- B. Comparison of Two Sorts
  1. Insertion sort
  2. Merge sort
- C. Analyzing algorithms and designing algorithms

II. The Growth of Functions
- A. Asymptotic notation
- B. Standard notations and common functions

III. Recurrences
- A. The substitution method
- B. The recursion-tree method
- C. The master method
- D. Proof of the master theorem

IV. Sorting
- A. Heapsort
  1. Heaps
  2. Maintaining the heap property
  3. Building a heap
  4. The heapsort algorithm
  5. Priority queues
- B. Quicksort
  1. Description of quicksort
  2. Performance of quicksort
  3. Randomized versions of quicksort
  4. Analysis of quicksort
- C. Sorting in Linear Time
  1. Lower bounds for sorting
  2. Counting sort
  3. Radix sort
  4. Bucket sort

V. Dynamic Programming
- A. Assembly-line scheduling
- B. Matrix-chain multiplication
- C. Elements of dynamic programming
- D. Longest common subsequence
- E. Optimal binary search trees

VI. Greedy Algorithms

A. An activity-selection problem
B. Elements of the greedy strategy
C. Huffman codes
D. Theoretical foundations for greedy methods
E. A task-scheduling problem

VII. Graph algorithms:

A. Disjoint Sets
    1. Disjoint-set operations
    2. Linked-list representation of disjoint sets
    3. Disjoint-set forests
    4. Analysis of union by rank with path compression
B. Minimum Spanning Trees
    1. Growing a minimum spanning tree
    2. The algorithms of Kruskal and Prim
C. Single-Source Shortest Paths
    1. The Bellman-Ford algorithm
    2. Single-source shortest paths in directed acyclic graphs
    3. Dijkstra's algorithm
    4. Difference constraints and shortest paths
    5. Proofs of shortest-paths properties

VIII. NP-Completeness

A. Polynomial time
B. Polynomial-time verification
C. NP-completeness and reducibility
D. NP-completeness proofs
E. NP-complete problems