CSE-835 Course Outline Fall 2020

1. **INTRODUCTION**
   - (a) Graphs and their Applications
   - (b) Outline of the Course
   - (c) Review
     - i. Algorithms
     - ii. Complexity Analysis
     - iii. Problem Solving Guidelines
2. **DEFINITIONS & NOTATION**
   - (a) Labeled and Unlabeled Graphs
   - (b) Invariants of a Graph
   - (c) Order, Size, Degree,
   - (d) Computer represention of graphs/digraphs
     - i. Adjacency and incidence matrices
     - ii. Adjacency and incidence lists
     - iii. Introduction to GMPX, PG, and Nauty
   - (e) Graphical Sequence
     - i. A characterization of graphical sequences
   - (f) Walks, Trails, Paths, Cycles
   - (g) Subgraphs of a Graph
   - (h) Induced Subgraphs
   - (i) Spanning Subgraphs
3. **SPECIAL GRAPHS**
   - (a) Connected and Disconnected Graphs/Digraphs
   - (b) Trees and Forests
   - (c) Complete Graphs & Tournaments
   - (d) Bipartite Graphs
     - i. A characterization of bipartite graphs
   - (e) Hamiltonian Graphs
   - (f) Eulerian Graphs/Digraphs
     - i. A characterization of Eulerian graphs
   - (g) Iterative Graphs
   - (h) Random Graphs
   - (i) Other Special Graphs
4. **TREES**
   - (a) Some Properties of Trees
   - (b) Spanning Trees of a Graph
   - (c) Optimal Spanning Trees
   - (d) Different Optimality Criteria
   - (e) Finding Optimal Spanning Trees
   - (f) Some Applications
5. **DIRECTED TREES**
   - (a) Some Properties of Directed Trees
6. **COUNTING TREES**
   - (a) Counting Spanning Trees of a Labeled Graph
7. **SEARCHING TECHNIQUES**
   - (a) Depth-First Search
     - i. Properties of DFS
   - (b) Breadth-First Search
     - i. Properties of BFS
   - (c) Some Applications
8. **SHORTEST-PATHS PROBLEMS**
   - (a) Problem Description
   - (b) Single-Source Single-Destination Problem
   - (c) Single-Source Multiple-Destination Problem
   - (d) Multiple Source-Destination Problem
   - (e) Some Applications
9. **MAXIMUM FLOW**
   - (a) Problem Description
   - (b) Evolution of Maximum-Flow Algorithms
   - (c) Ford-Fulkerson Results
   - (d) Edmond-Karp Algorithm
   - (e) MPM Algorithm
   - (f) Other MFAs
10. **APPLICATIONS OF MAXIMUM-FLOW**
    - (a) Finding Arc-Disjoint paths
    - (b) Finding edge-disjoint Paths
    - (c) Finding vertex-disjoint paths
11. **GRAPH CONNECTIVITIES**
    - (a) Problem Description
    - (b) Evolution of Connectivity Algorithms
    - (c) Computing λ of a Graph
    - (d) Computing κ of a Graph
    - (e) Computing λ of a Digraph
12. **CONNECTIVITY GENERALIZATIONS**
    - (a) Problem Description
    - (b) Conditional Connectivities
    - (c) Restricted Connectivities
    - (d) Some Applications
13. **MATCHINGS**
    - (a) Problem Description
    - (b) Matching Algorithms
    - (c) Some Application
14. **SPECIAL VERTEX SUBSETS**
    - (a) Covering Sets
    - (b) Independent Sets
    - (c) Dominating Sets