

University of Sri Jayewardenepura
Department of Mathematics
B.Sc.Honours Degree in Mathematics
Semester 2 - 2020
MAT 354 3.0 Graph Theory (Special Degree)

Lecturer-in-Charge	Duration	Lect. Room	Email	Time
Dr. G.H.J. Lanel	45 Hours	M2	ghjlanel@sjp.ac.lk	Fri: 8.55am -12.00noon

Course Description and Objectives

The objectives of this course are

- to understand various design strategies for an algorithm,
- to learn how to analyze algorithm correctness and efficiency,
- to be familiarized to a variety of algorithms in different settings.

Intended Learning Outcomes

By the end of this class, students will:

1. Be able to develop algorithms to meet requirements.
2. Be able to develop arguments for the validity of the algorithm.
3. Be familiar with classical strategies in algorithmic design and know how to apply them.
4. Be able to compute the time complexity of algorithms.

Course Syllabus

1. Graphs
 - 1.1. Basic Definitions in Graph Theory
 - 1.2. Traveling Through a Graph

- 1.2.1. Connectedness
- 1.2.2. Euler Tours
- 1.2.3. Hamiltonian Cycles
- 1.3. Graph Representation
 - 1.3.1. Adjacency Matrices
 - 1.3.2. Adjacency Lists
- 1.4. Planarity of Graphs
 - 1.4.1. Euler's Formula
 - 1.4.2. Kuratowski's Theorem
- 1.5. Coloring of Graphs
 - 1.5.1. Vertex Coloring, Edge Coloring, Face Coloring and Chromatic Number
 - 1.5.2. Color Theorems
- 2. Trees
 - 2.1. Basic Definitions for Trees
 - 2.1.1. Rooted Trees
 - 2.1.2. Ordered Trees, Binary Trees and m-ary Trees
 - 2.2. Spanning Trees
 - 2.2.1. Depth First Search
 - 2.2.2. Breadth First Search
 - 2.3. Minimum Spanning Trees
 - 2.3.1. Prim's Algorithm
 - 2.3.2. Kruskal's Algorithm
- 3. Paths and Flows
 - 3.1. Shortest Paths and Longest Paths
 - 3.1.1. Dijkstra's Algorithm
 - 3.1.2. Single-source(sink) Shortest Paths
 - 3.1.2. Multiple-source(Sink) Shortest Paths
 - 3.2. Flows

3.2.1. The Ford-Fulkerson Algorithm

3.2.2. The Maxflow-Mincut Theorem

4. Matching

4.1. Matching and Covers

4.1.1. Maximum Matching

4.1.2. Hall's Matching Condition

4.1.3. Min-Max Theorem

4.1.4. Independent Sets and Covers

4.1.5. Dominating Sets

4.2. Algorithms and Applications

4.2.1. Maximum Bipartite Matching

4.2.2. Weighted Bipartite Matching

4.2.3. Stable Matching

References:

- Thomas H. Cormen, Charles E. Leiserson, and Ronald L. Rivest, *Introduction to Algorithms*, Second Edition, MIT Press/McGraw-Hill, 1990.
- Jerrold W. Grossman, *Discrete Mathematics (An Introduction to Concepts, Methods, and Applications)*, First Edition, Macmillan Publishing Company, 1990.

Assessment Criterion:

Assignments (AS1)	20%
Midterm Examination (AS2)	20%
End of Semester Examination (AS3)	60%

Course Blueprint (ILO-PLO-AS Map)

PLOs	ILO1	ILO2	ILO3	ILO4
1	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
2	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
2	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
4	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
5	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
6	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
7	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3

PLO-ILO Map

PLOs	ILO1	ILO2	ILO3	ILO4
1	✓	✓	✓	✓
2	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✓
4	✓	✓	✓	✓
5	✓	✓	✓	✓
6	✓	✓	✓	✓
7	✓	✓	✓	✓

Teaching Learning Activities (TLA)

1. Teacher-Student interaction/ lectures (TLA1)
2. Student-Centered learning (TLA2)
3. Problem Solving/Practice on critical thinking (TLA3)
4. Discussions (TLA4)

ILO-TLA-AS Map

ILOs	TLA1	TLA2	TLA3	TLA4
1	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
2	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
2	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
4	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
5	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
6	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3
7	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3	✓ AS1,AS2,AS3