B.Sc. (Honours) Degree Program
Faculty of Applied Sciences
University of Sri Jayewardenepura

Course Title	Graph Theory
Course Code	**MAT 353 3.0**
Credit Value	3
Status	Core
Year / Level	3
Semester	2
Theory: Practical: Independent Learning	45: 0: 105
Other: Pre-requisite Course/s	-

Aim/Objectives of the Course:

The objectives of this course are as follows:
1. understand the basic graph theory concepts,
2. perform basic computation in graph related problems,
3. apply the knowledge of graph theory to understand real world problems.

Intended Learning Outcomes:

On successful completion of this module, the student should be able to

1. demonstrate an understanding of the general concepts in graph theory,
2. apply the abstract concepts of graph theory in modeling and solving problems in different fields of study,
3. demonstrate the abilities in critical thinking and problem solving.

Course Content:

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
       3.1.3. 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

Scope and Schedule of Teaching - Learning Activities:

Topic No.	Topic / Sub Topic	No. of Hrs.			Teaching Method	Assessment Criteria	ILO Alignment
		T	P	IL			
1	**Graphs**						
1.1	Basic Definitions in Graph Theory	3		8			1
1.2	Traveling Through a Graph	3		8	Lectures/		1
1.3	Graph Representation	3		8	Handouts	Assignment	1
1.4	Planarity of Graphs	3		8	1,2,3,4		1
1.5	Coloring of Graphs	3		10		Quiz	1
2	**Trees**						
2.1	Basic Definitions for Trees	3		8	Lectures/		1,2,3
2.2	Spanning Trees	3		8	Handouts		1,2,3
2.3	Minimum Spanning Trees	3		8	5,6,7,8	Mid Exam	1,2,3

3	**Paths and Flows**						
3.1	Shortest Paths and Longest Paths	3		9	Lecture / Handouts 9,10		1,2,3
3.2	Flows	6		10		Assignment	1,2,3
4	**Matching**						
4.1	Matching and Covers	6		10	Lecture/ Handouts 11,12		4
4.2	Algorithms and Applications	6		10		Quiz and Mini Project	4
	Total	45	0	105			

Linking Program Outcomes with ILOs:

Program Outcomes:

1. Demonstrate advanced knowledge and understanding of underlying concepts of respective subject areas
2. Acquire high levels of competence in practical/technical knowledge and skills for professional growth
3. Enhance ability to communicate acquired knowledge, information, ideas and solutions with clarity and coherence.
4. Enhance emotional intelligence through social engagement, networking and teamwork which leads to improved leadership qualities, respect for diverse points of view and empathy and develop strategies to adapt to changing circumstances.
5. Develop cognitive and creative skills in identifying, collecting, and critically analyzing data and in solving problems independently.
6. Exercise personal integrity through responsibility and accountability and acquire professional integrity through inculcated entrepreneurial, managerial, and time-management skills.
7. Demonstrate positive and healthy attitudes and values and engage in lifelong learning for the betterment of society.

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
ILO 1	***	**	*	*			*
ILO 2	***	**	*	*	***	***	*
ILO 3	***	***	**	**	***	***	*
ILO 4	***	***	**	**	***	***	*

*** - *Strongly Linked; ** - Medium linked; * Weakly linked*

Mode of Assessment:

Formative Assessment(FA): Continuous Assessment: Assignments, Quizzes, Mid Semester Examination and   Mini Projects = 40% of Total Marks

Summative Assessment (SA): End Semester Examination: 3-hour paper = 60% of Total Marks

References

- Jonathan L. Gross and Jay Yellon, Graph Theory and Its Applications, second edition, 2006

- Jerrold W. Grossman, Discrete Mathematics (An Introduction to Concepts, Methods, and Applications), First Edition, Macmillan Publishing Company, 1990.

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