

**Hong Kong Baptist University**  
**Faculty of Science**  
**Department of Mathematics**

**Title (Units):** MATH 2610 GRAPH THEORY (3,3,0)

**Course Aims:** This course covers some fundamental concepts and principles of graph theory. Some algorithms of graphs are also discussed. Students will learn some techniques to solve some graph problems.

**Prerequisite:** Year 2 Standing

**Prepared by:** W.C. Shiu

**Learning Outcomes (LOs):**

Upon successful completion of this course, students should be:

No.	Learning Outcomes (LOs)
	<b>Knowledge</b>
1	Able to understand the basic concepts of graphs, directed graphs, and weighted graphs
2	Able to understand the properties of bipartite graphs, particularly in trees
3	Able to understand the concept of colorings and theory
4	Able to understand Eulerian and Hamiltonian graphs
5	Able to understand the concept of plane graph and theory
	<b>Skill</b>
6	Able to apply shortest path algorithm to solve Chinese Postman Problem
7	Able to apply coloring algorithms to color a given graph or to find its chromatic polynomial
8	Able to present a graph by matrices
9	Able to find a minimal spanning tree for a given weighted graph
10	Able to apply the knowledge of graph to solve the real life problem
	<b>Attitude</b>
11	Able to appreciate the structure of graphs

**Assessment:**

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment (assignments and test)	30%	A 1-hour Test and Continuous Assessment are designed to measure how well the students have learned the fundamental concepts and theory.
2	Final Examination	70%	Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess the student's versatility in solving graph problems.

**Learning Outcomes and Weighting:**

Content	LO No.	Teaching (in hours)
I. Graphs and Directed Graphs	1, 10	7
II. Matrix Representations	1, 8	3
III. Trees and Bipartite Graphs	2, 10, 11	8
IV. Eulerian and Hamiltonian Graphs	4, 6, 10	5
V. Plane Graphs	5, 11	5
VI. Graph Colorings	3, 7, 10	6
VII. Graph Algorithms	6, 7, 8, 9, 10	4

**Textbook:**

G. Agnarsson and R. Greenlaw, Graph Theory: Modeling, Applications, and Algorithms, Prentice Hall, Pearson Education International, 2007.

**References:**

J.A. Bondy and U.S.R. Murty, Graph Theory with Applications, Macmillan, 1976.  
 G. Chartrand and L. Lesniak, Graphs & Digraphs, 3<sup>rd</sup> Ed., Chapman & Hall, 1996.  
 J. Clark and D.A. Holton, A First Look at Graph Theory, World Scientific, 1996.  
 J.A. McHugh, Algorithmic Graph Theory, Prentice-Hall, 1990.  
 D.B. West, Introduction To Graph Theory, Prentice-Hall, 1996  
 R.J. Wilson and J.J. Watkins, Graphs, An Introductory Approach, John Wiley and Son, 1990.  
 邵慰慈，潘建強：基礎離散數學，九章出版社，2005.

**Course Content in Outline:**

<u>Topic</u>	<u>Hours</u>
I. Graphs and Directed Graphs	7
A. Definitions and basic properties	
B. Subgraphs and types of graphs	
C. Isomorphic graphs	
D. Graph operations	
E. Connectivity	
II. Matrix Representations	3
A. Adjacency matrix	
B. Incident matrix	
C. Distance matrix	
III. Trees and Bipartite Graphs	8
A. Definition and basic properties	
B. Bipartite graphs	
C. Centers in trees	
D. Spanning tree and Cayley's formula	
E. Minimal spanning trees and algorithms	
IV. Eulerian and Hamiltonian Graphs	5
A. Euler tours	
B. Chinese Postman Problem	
C. Hamiltonian graphs	
D. Traveling salesman problem	
V. Plane Graphs	5
A. Plane graphs	
B. Euler's formula	
C. Kuratowski and Wagner's theorem	
D. Plane duality	
VI. Graph Colorings	6
A. Vertex coloring and algorithms	
B. Edge coloring	
C. Map coloring five color theorem	
D. Chromatic polynomial	
VII. Graph Algorithms	4
A. Dijkstra's shortest path algorithm	
B. Graph coloring algorithm including chromatic polynomial	
VIII. Selected Topic (Optional)	
<b>Total</b>	<b>38</b>