Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): **MATH3850 OPTIMIZATION THEORY AND TECHNIQUES (3,3,0)**

Course Aims: This course aims to

- **a)** provide the fundamental theory and techniques in unconstrained and constrained optimization;
- **b)** introduce some existing numerical software packages;
- **c)** offer some interdisciplinary techniques and applications related to optimization.

Prerequisite: Year 2 or Year 3 standing, or consent of the instructor

Prepared by: X. M. Yuan

Learning Outcomes (LOs):

Upon successful completion of this course, students should be:

No.	Learning Outcomes (LOs)
	Knowledge
1	Able to understand the basic theory of Optimization
2	Able to understand some classical numerical algorithms of Optimization
3	Able to know some hot topics of current research in Optimization
	Skill
4	Able to build up Optimization models for some applications problems
5	Able to implement some algorithms by scientific software such as Matlab
6	Able to analyze the complexity of algorithms
	Attitude
7	Able to work effectively in a team
8	Able to solve problems independently

Assessment:

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment (assignments, test, and mini-project)	30%	Assignments are designed to measure students understanding of the theory and techniques of Optimization. The mini-project is designed to train the students' ability to work in a team environment to design and implement creative solutions to an Optimization problem.
2	Final Examination	70%	Final Examination is designed to see how far students have achieved their intended learning outcomes especially in the Knowledge domain. Students should have a thorough understanding of the knowledge and apply them correctly in different context to do well in the exam.

Learning Outcomes and Weighting:

Content	LO No.	Teaching (in hours)
I. Fundamentals	1, 4	4
II. Optimality Conditions	1,6	4
III. Unconstrained Methods	1-3,5-7	14
IV. Constrained Methods	1-3,5-7	14
V. Other Selected Topics	3-5,7-8	6

Textbook: Lecture notes prepared by the instructor

References:

1.D.G. Luenberger, Linear and Nonlinear Programming, 2nd Ed., Addison-Wesley, 1984.
2. R. Fletcher, Practical Methods of Optimization, 2nd Ed., John Wiley & Sons, 1987.
3. S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004.
4. J. Nocedal and S. Wright, Numerical Optimization, Springer, 1999.
5. J.E. Dennis, Jr., R.B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM, 1996.

Software: Matlab

Course Content in Outline:

	Topic	Hours
I.	Fundamentals	4
	A. Multivariable Calculus Background	
	B. Numerical Linear Algebra Background	
II.	Optimality Conditions	4
	A. Unconstrained Optimization	
	B. Linearly Constrained Optimization	
	C. Nonlinearly Constrained Optimization	
III.	Unconstrained Methods	14
	A. Second Derivative Methods	
	B. First Derivative Methods	
	C. Derivative-free Methods	
IV.	Constrained Methods	14
	A. Penalty and Barrier Function Methods	
	B. Augmented Lagrangian Methods	
	C. Projected Lagrangian Methods	
V.	Other Selected Topics	6
	A. Variational Inequalities	
	B. Continuous Methods	
	C. Interior Point Methods	