國立台灣科技大學 114學年 第2學期　課程大綱

Spring 2026 NTUST Course Outline

授課教師：方文賢

Instructor:Fang, Wen-Hsien

課程名稱：訊號處理之凸面最佳化方法

Course Title：Convex Optimization Methods for Signal Processing

2026/11/3

課程代號：ET5117701 Course Code 學分數：3 Credits	必選修：選修/半學年 Required/Electve:Elective/Half Yr. 先修課程： Prerequisites
節次教室：M2(IB-602-1) M3(IB-602-1) M4(IB-602-1) Time/Location	
專業核心能力： Core Professional Competencies	
課程網址： Course Website	
課程宗旨： Course Objectives	This course introduces the convex optimization methods and its applications in signal processing, wireless communication and emerging research areas. The course covers basic convex optimization theory, problem formulation/reformulation principles, optimization algorithms and important applications in signal processing problems. The course aims to improve students' capabilities in problem formulation, problem solving and performance analysis
課程大綱： Outline of Lectures	PART I: Theory 1. Mathematical reviews: Sets and functions; basic concepts of vector space; matrix algebra, matrix/vector measures, matrix factorizations and gradients. 2. General Unconstrained minimization: basic concepts; steepest descent methods; Newton's methods. 3. Convex sets: affine and convex sets; some common convex sets; operations that preserve convexity; general inequality. 4. Convex functions: basic properties; some common convex functions; operations that preserve convexity. 5. Convex optimization problems: convex optimization; linear optimization problems; quadratic optimization problems; geometric programming; multi-objective functions;. 6. Duality: Lagrange dual functions and problems; KKT conditions. PART II: Applications 1. Filter design: formulation; design examples. 2. Approximation and fitting: conventional least-square problem; norm-approximation; sparsity and compressed sensing; regularization. 3. Support vector machine. 4. Backpropagation algorithm.
授課方式： Method of Instruction	講授 Lecture：100% 分組討論 Group discussion：0% 案例研討 Case study：0% 操做練習 Practical exercises：0% 講授 Lecture：%

教科書： Textbooks	1. S. Boyd and L. Vandenberghe, Convex Optimization. U.K.: Cambridge University Press, 2004. 2. E. K. P. Chong and S. H. Zak, An Introduction to Optimization}, 4th ed. John Wiley, New Jersey, 2013. 3. S. Boyd and L. Vandenberghe, Introduction to Applied Linear Algebra - Vectors, Matrices, and Least Squares. Cambridge University Press, 2018
參考書目： References	1. D. P. Bertsekas, Convex Optimization Theory, Athena Scientific, 2009. 2. C.-Y. Chi, W.-C. Li, and C.-H. Lin, Convex Optimization for Signal Processing and Communications: From Fundamentals to Applications, CRC Press, 2017. 3. S. L. Brunton and J. N. Kutz, Data-Driven Science and Engineering: Machine Learning, Dynamic Systems, and Control. Cambridge University Press, 2019. 4. IEEE Signal Processing Magazine, special issue on convex optimization, 2006.
修課須知： Notice	- 有助教TA - 有輔助投影片
評量方式： Grading	Midterm 45 %, Homework (including computer exercises) 25 %, and a final project 30%.
備註說明： Notes	Background in Calculus, linear algebra, and matrix computations.