通訊所專業必修/必選修課程綱要表

課程名稱：（中文）通訊之最佳化方法	開課學程	通訊所
（英文）Optimization for Communications	課程代碼	COM5245

授課教師：祁忠勇

學分數	3	必/選修	選修	開課年級	碩士班、博士班

先修科目或先備能力：線性代數

課程概述與目標：This course is designed for students to smoothly and efficiently learn how to solve an optimization problem, from the fundamental theory, problem definition, reformation into a convex problem, analysis, algorithm implementation, to cutting edge researches (like an exploration journey rather than pure mathematics) in signal processing, communications, etc.

教科書 [1]	Lecture notes: Chong-Yung Chi, "Convex Optimization for Signal Processing and Communications" (around 300 pages)
參考書目	1. Boyd and Vandenberghe, *Convex Optimization,* Cambridge University Press, Cambridge, 2004. E-book can be downloaded from: http://www.stanford.edu/~boyd/cvxbook/ 2. R. Fletcher, *Practical Methods of Optimization*, John Wiley and Sons, 1988. 3. D. P. Bertsekas, *Convex Analysis and Optimization*, Athena Scientific, 2003. 4. D. P. Bertsekas, *Convex Optimization Theory*, Athena Scientific, 2009. 5. Daniel P. Palomar and Yonina C. Eldar (Editors), *Convex Optimization in Signal Processing and Communications,* Cambridge University Press, Cambridge, 2010.

對應之學生核心能力	核心能力達成指標	比例
1. 發掘、分析、解決問題與獨立研究之能力	A.具備發掘問題之能力 B.具備分析問題之能力 C.具備解決問題之能力 D.具備獨立研究之能力	25%
2.通訊科技整合與創新之能力	A.具備整合通訊知識之能力 B.具備創新通訊科技知識之能力	15%
3.學習新知識與技術之能力	A. 具備主動學習新知識之能力 B. 具備學習新技術之能力	40%
4.良好溝通、表達與外語能力	A. 具備與通訊專業人員溝通與表達專業知識之能力 B. 具備外語專業能力用以溝通通訊專業知識	10%
5. 具團隊精神及遵守專業倫理	A.具備團隊合作之能力與精神 B.能遵守專業倫理	10%

課程綱要	內容綱要	核心能力達成指標（請勾選）
1. Background materials in linear algebra and matrix theory	1. Mathematical prerequisites 2. Linear algebra revisited	1-□A■B□C□D 2-□A□B 3-□A□B 4-□A□B 5-□A□B
2. Convex sets	1. Affine and Convex sets 2. Convexity preserving operations 3. Generalized inequalities 4. Dual norm and Dual cones 5. Separating and Supporting hyperplanes	1-□A■B■C□D 2-■A□B 3-□A■B 4-■A□B 5-□A□B
3. Convex functions	1. Basic properties and examples 2. Convexity preserving operations 3. Quasiconvex functions 4. Monotonicity on generalized inequality 5. Convexity on generalized inequality	1-□A■B■C□D 2-■A□B 3-□A■B 4-■A□B 5-□A□B
4. Convex optimization problems	1. Optimization problems in a standard form 2. Convex optimization problems 3. Equivalent representations and transforms 4. Standard form with generalized inequalities 5. Quasiconvex optimization	1-■A■B■C□D 2-■A■B 3-■A■B 4-■A□B 5-□A□B
5. Duality	1. Lagrange dual function and Conjugate function 2. Dual problem 3. Strong duality 4. Implications of strong duality 5. Karush-Kuhn-Tucker (KKT) optimality conditions 6. Dual optimization 7. Duality of problems with generalized inequalities 8. Theorems of alternatives	1-□A■B■C□D 2-■A□B 3-■A■B 4-■A□B 5-□A□B
6. Interior-point methods	1. Newton's method and barrier function 2. Central path 3. Barrier method 4. Primal-dual interior-point methods	1-□A■B■C□D 2-■A■B 3-■A■B 4-■A□B 5-□A□B
7. Applications to engineering problems	1. Signal Processing: Blind source separation for biomedical and hyperspectral image analysis. 2. Communications: Coherent/noncoherent	1-■A■B■C■D 2-■A■B 3-■A■B

	detection, space-time coding, beamforming, and resource allocation in multiple-input multiple-output (MIMO) communications and networking.	4-■A■B 5-■A■B

教學要點概述 [2]：

1. 教材編選：本課程之教材為自行編撰，並以參考書輔助教學。
2. 教學方法：上課講解
3. 評量方法：Homework: 15%;

           Midterm Exam: 30%; (written examination in class)

           Final Exam: 30%; (written examination in class)

           Term Project: 25% (no more than 2 persons per group)
4. 教學資源：投影機、投影筆、筆記型電腦、無線麥克風

註：1. 教科書請註明書名、作者、出版社、出版年等資訊。

    2. 教學要點概述請填寫教材編選、教學方法、評量方法、教學資源、教學相關配合事項等。

    3. 研究所所有開設之課程皆須填寫此表格或提供原有格式之課程綱要表，並呈現於實地訪評現場。