

# Convex Optimization in SPCOM

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1. Pre-requisite: Linear Algebra
2. Objective: Convex optimization has recently been applied to a wide variety of problems in EE, especially in signal processing, communications, and networks. The aim of this course is to train the students in application and analysis of convex optimization problems in signal processing and wireless communications. At the end of this course, the students are expected to:
  - Know about the applications of convex optimization in signal processing, wireless communications, and networking research.
  - Be able to recognize convex optimization problems arising in these areas.
  - Be able to recognize 'hidden' convexity in many seemingly non-convex problems; formulate them as convex problems.
  - Be able to develop low-complexity, approximate solutions for difficult non-convex problems.
3. References:
  1. Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press. [Online]. <http://www.stanford.edu/~boyd/cvxbook/>
  2. Convex Optimization in Signal Processing and Communications, D. P. Palomar, Y. C. Eldar. Cambridge Press, 2010.
  3. [IEEE Signal Processing Magazine- Special Issue on Advances in Convex Optimization](#), Vol. 27, No. 3, May 2010.
  4. Dimitri P. Bertsekas, Convex Analysis and Optimization, Athena-Scientific, 2003.
4. Course Content:
  - a. Background on Linear algebra (Inner Product, Norm, EVD, SVD)
  - b. Affine sets, convex sets, cones
  - c. Convex functions, zeroth, first, and second order conditions for convexity
  - d. Convex optimization problems, change of variables, LP, QP
  - e. Second order cone programming, Robust optimization
  - f. Lagrange duality, KKT conditions
  - g. Conjugate functions, Linear Fractional Programming
  - h. Zero Sum Games
  - i. Geometric Programming and applications in power control
  - j. Schur's complement, Linear matrix inequality, SDP
  - k. Semidefinite relaxation
5. Format:
  - a. Assignments (no penalty for incorrect but valid attempts): 20%
  - b. Mini-quizzes (online): 30%
  - c. Attendance in discussions: 10%
  - d. EndSem Exam (online): 40%