Subject Description Form

Subject Code	COMP5542
Subject Title	Optimization and Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To acquire fundamental knowledge in optimization; 2. To learn about optimization methods and techniques in the context of information technology, engineering, and investment; and 3. To apply the knowledge in optimization and problem-solving.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. identify typical optimization problems in information technology, engineering, and investment; b. formulate optimization problems according to application requirements; c. demonstrate in-depth understanding of common optimization techniques; and d. select suitable optimization solvers and configurations to solve given optimization problems.
Subject Synopsis/ Indicative Syllabus	This subject will focus on mathematical programming problems as well as their applications. • **Formulation of optimization problems:** Decision variables, objective functions, constraints, standard formulations: linear programming, nonlinear programming and convex programming, simple graphical solutions, validity and tractability. • **Linear programming:** Simplex method, slack variables, duality, convergence, variants of linear programming, integer programming, iterative method. • **Nonlinear programming:** Quadratic programming, Lagrange multipliers, Karush-Kuhn-Tucker conditions, Newton's method, steepest descent, conjugate gradient, branch-and-bound. • **Convex programming:** Convex sets, convex functions, conjugate duality, semidefinite programming, interior-point, first order method. • **Optimization solvers:** CPLEX, MATLAB, OptimJ. • **Applications:** Scheduling, energy minimization, network flow, portfolio optimization, prediction and forecasting, etc.

<table>
<tr><td>Teaching/Learning Methodology</td><td>A mix of lectures and tutorials is used to deliver the various topics in this subject. Lectures are conducted to cover principles, methods, and techniques of optimization. During tutorial sessions, students use the principles to formulate various optimization problems, and learn to use the major optimization solvers (both open-source and commercial). The projects provide students the opportunity to gain hands-on experience on the solvers.

39 hours of class activities including lectures and tutorials.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="4">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Assignments, Tests & Projects</td><td>55</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Final Examination</td><td>45</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100</td><td colspan="4"></td></tr>
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<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Class activities (lecture, tutorial)</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignments, Quizzes, Projects, Exams</td><td>66 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
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<tr><td>Reading List and References</td><td>

Nemhauser, G. L., Wolsey, L. A. (1999), Integer and Combinatorial Optimization, Wiley, New York.
David G. Luenberger and Yinyu Ye (2016), Linear and Nonlinear Programming, 4th ed., Springer.
Mokhtar S. Bazaraa, Hanif D. Sherali, and C. M. Shetty (2006), Nonlinear Programming: Theory and Algorithms, 3rd Ed, Wiley, New Jersey.
Stephen Boyd and Lieven Vandenberghe (2008), Convex Optimization (With Corrections), Cambridge University Press, Cambridge UK.

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