Subject Description Form

Subject Code	AMA4850
Subject Title	Optimization Methods
Credit Value	3
Level	4
Pre-requisite	▪ Intermediate Calculus and Linear Algebra (AMA2007/AMA2707) or ▪ Mathematics I (AMA2111) or ▪ Mathematics for Engineers (AMA2131/AMA2308) or ▪ Applied Mathematics II (AMA2512) or ▪ Mathematics for Scientists and Engineers (AMA2882) or ▪ Engineering Mathematics (AMA290) or ▪ Mathematical Methods for Data Science (AMA3001/AMA3701) or ▪ Further Mathematical Methods (AMA3724) or ▪ **Both** Basic Mathematics II – Calculus and Linear Algebra (AMA1120) **and** Engineering Mathematics (AMA2380)
Exclusion	Optimization Methods (AMA485)
Objectives	To enable students to learn to use more advanced mathematical and computational techniques in optimization, applicable in solving real engineering and management problems.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: 1. Formulate problems as semidefinite programming, unconstrained nonlinear programming and constrained nonlinear programming problems; 2. Master optimality conditions for continuous optimization and duality theory for semidefinite programs; 3. Apply the main algorithms for solving semidefinite programming, unconstrained nonlinear programming and constrained nonlinear programming problems.
Subject Synopsis/ Indicative Syllabus	*Linear conic programming:* Convex sets, separation theorem; convex functions, operations that preserve convexity; linear programming and semidefinite programming (SDP) duality, Schur complement and SDP representations; applications of SDP problems in compressed sensing and portfolio selections, solvers for SDP *Unconstrained optimization:* Steepest descent method; Newton's method; Exact line search and Armijo line search with backtracking; Quasi-Newton method. *Constrained Optimization:* Karush-Kuhn-Tucker conditions; Mangasarian-Fromovitz constraint qualification;

penalty and barrier functions.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the concepts of optimization methods in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		1	2	3
a. Assignments	10%	✓	✓	✓
b. Tests	30%	✓	✓	✓
c. Examination	60%	✓	✓	✓
Total	100 %			

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skills and understanding of **Optimization Methods,** thus, **Exam-based assessment** is the most appropriate assessment method, including 60% examination. Continuous Assessment comprises individual assignments (10%) and test (30%) are included so as to keep the students in progress.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.
• Tutorial	13 Hrs.
Other student study effort:	
• Assignment	15 Hrs.
• Self-study	55 Hrs.
Total student study effort	109 Hrs.

Reading List and References

Reference:

A. Beck	Introduction to Nonlinear Optimization: Theory, Algorithms, and Applications with MATLAB	SIAM 2014
D. P. Bertsekas	Nonlinear Programming, 3rd edition	Athena Pacific 2016
S. Boyd and L. Vandenberghe	Convex Optimization	Cambridge University

			Press 2004
	Y. Nesterov	Introductory Lectures on Convex Optimization	Springer 2004
	J. Nocedal and S. J. Wright	Numerical Optimization, 2^{nd} edition	Springer 2006
	Rockafellar, R.T.	Convex Analysis	Princeton University Press 1970