

MA5243 Advanced Mathematical Programming

Course Syllabus: Fall 2025

Lecture	Lecture Theatre 52 (UTSRC-LT52), 12:00 PM – 14:00 PM every Monday and Wednesday
Instructor	Shaoning Han Email: shaoninghan@nus.edu.sg Office hours: by appointment
Reference Books	<ul style="list-style-type: none">• ANDRZEJ RUSZCZYNSKI, <i>Nonlinear Optimization</i>, Princeton University Press (2011).• JORGE NOCEDAL AND STEPHEN J. WRIGHT, <i>Numerical Optimization</i>, Second Edition, Springer (2006).• DIMITRI P. BERTSEKAS, <i>Nonlinear Programming</i>, Third Edition, Athena Scientific (2016).

Course Description: MA5243 is a 4-unit course designed for Ph.D. students in mathematics. The goal of this course is to establish the mathematical foundations of general continuous optimization problems. It covers a variety of topics: Introduction to convex analysis; Optimality conditions; duality theory; Classical nonlinear programming algorithms including line search methods, Newton and quasi Newton methods, trust-region methods, sequential QP, penalty, barrier and augmented Lagrangian methods; First-order methods for nonsmooth convex optimization problems. Most lectures are based on course notes, with both handwritten and typeset versions posted on Canvas after class. There is **no** required textbook.

Prerequisite: There is no prerequisite required for graduate students. Undergraduates students must have completed MA3236 at a grade of at least A-; those who do not meet this prerequisite can seek departmental approval to enroll.

Exam: The exams are closed-book. Students can take one double-sided A4 size helpsheet prepared by their own. No other exam tools are allowed.

Grade Distribution:

- Class Participation (20%)
- Midterm on **September 29** (30%)
- Final exam on **December 4** (50%)

Homework: There will be no homework assignments. However, as in other mathematics courses, working through exercises is essential for mastering the concepts and techniques covered in class. A booklet of exercises will be posted on Canvas and will be continuously updated throughout the semester.

Email Policy: Do not expect immediate responses to emailed questions. I will try to respond to all emailed questions within 48 hours. Try to keep your email short and direct. It is advised that you include “MA5243” as part of your email title/subject.

Tentative Course Plan:

- Introduction to convex analysis (6 lectures)
- Optimality conditions (3 lectures)
- Duality theory (2 lectures)
- Algorithms for unconstrained optimization (7 lectures)
- Algorithms for constrained optimization (3 lectures)
- First order methods for nonsmooth convex optimization (3 lectures)

University policies

• *Statement on Academic Integrity.* The University is committed to nurturing an environment conducive for the exchange of ideas, advancement of knowledge and intellectual development. Academic honesty and integrity are essential conditions for the pursuit and acquisition of knowledge, and the University expects each student to maintain and uphold the highest standards of integrity and academic honesty at all times. The University takes a strict view of cheating in any form, deceptive fabrication, plagiarism and violation of intellectual property and copyright laws. Any student who is found to have engaged in such misconduct will be subject to disciplinary action by the University. Students are referred to <https://www.comp.nus.edu.sg/cug/plagiarism> and <https://www.usp.nus.edu.sg/curriculum/plagiarism> for more detailed standards and policies on plagiarism & academic dishonesty.

• *Statement for Students with Disabilities.* NUS strives to provide an inclusive and nurturing campus environment for students with disabilities or accessibility needs to achieve their fullest potential. The Student Accessibility Unit (SAU) serves as a key touchpoint dedicated to supporting the range of access needs that students may have. The unit works closely with NUS offices and external partners to facilitate and provide individualised support services and resources to meet students' diverse needs. More guidance and information can be found at <https://nus.edu.sg/osa/orientation/resources/accessibility-support> and <https://osa.nus.edu.sg/services-support/accessibility-support/>. Contact email of SAU: accessibility@nus.edu.sg.