Course information 2026-27

MT3042 Optimisation Theory

General information

MODULE LEVEL: 6

CREDIT: 15

NOTIONAL STUDY TIME: 150 hours

MODE: Locally Taught and Independent Learner Route Only (not available for Online Taught students)

Summary

This half course brings together several parts of the wide area of mathematical optimisation, as encountered in many applied fields. The emphasis is on the mathematical ideas and theory used in combinatorial, linear, and continuous optimisation.

Conditions

Please refer to the relevant programme structure in the EMFSS Programme Regulations to check:

- where this course can be placed on your degree structure; and
- details of prerequisites and corequisites for this course.

You should also refer to the Exclusions list in the EMFSS Programme Regulations to check if any exclusions apply for this course.

Aims and objectives

This half course is designed to:

- Enable students to obtain a rigorous mathematical background to optimisation techniques used in areas such as logistics, economics, and finance
- Enable students to understand the connections between various optimisation approaches, the difference between combinatorial and continuous problems, and about the suitability and limitations of optimisation methods for different purposes.

Learning outcomes

At the end of this course and having completed the essential reading and activities students should be able to:

- Have knowledge and understanding of important definitions, concepts and results in the subject, and of how to apply these in different situations
- Have knowledge of basic techniques and methodologies in the topics covered
- Have basic understanding of the theoretical aspects of the concepts and methodologies covered
- Be able to understand new situations and definitions, including combinations with elements from different areas covered in the course, investigate their properties, and relate them to existing knowledge
- Be able to think critically and with sufficient mathematical rigour.

Employability skills

Below are the three most relevant employability skills that students acquire by undertaking this course which can be conveyed to future prospective employers:

1. Complex problem solving
2. Decision making
3. Adaptability and resilience

Essential reading

The main text is the detailed course guide as essential reading.

Assessment

This course is assessed by a two-hour and fifteen-minute closed-book written examination.

Syllabus

This course aims to bring together several parts of the wide area of mathematical optimisation, as encountered in many applied fields. The course starts with an introduction to combinatorial optimisation with the discrete problem of finding shortest paths in networks.

Subsequent parts concentrate on continuous optimisation, and in this sense extend the theory studied in standard calculus courses. In contrast to the Mathematics 1 and Mathematics 2 half courses, the emphasis in this part Optimisation Theory course will be on the mathematical ideas and theory used in continuous optimisation.

The final part on linear programming and its duality theorem relates to both combinatorial and continuous optimisation.

This course covers the following topics:

- Introduction to combinatorial optimisation. Shortest paths in directed graphs. Algorithms and their running time.
- Introduction and review of relevant parts from real analysis, with emphasis on higher dimensions.
- Classical results on continuous optimisation: Weierstrass's Theorem concerning continuous functions on compact sets. Review with added rigour of unconstrained optimisation of differentiable functions on open sets. Lagrange's Theorem on equality-constrained optimisation. Karush, Kuhn, and Tucker's Theorem on inequality-constrained optimisation.
- Linear programming and duality.