MS5041
Operational Optimization

Project Assignment

Report and Presentation Material Submission Date: 16-06-2025

Upload them via this link: https://bit.ly/25-ms5041

Presentation Date: TBD

Project Guidelines

- The project shall involve the formulation and solution of an **optimization problem based on an engineering case study** relevant to the students' academic discipline (mechanical, aerospace, materials engineering).
- The project shall be completed in **groups consisting of two to four students** (depending on your lecturers).
- Each group is permitted to **propose a topic of their own choosing**, subject to approval by the instructor.
- Each group must work on a **distinct topic**; topic duplication between groups is not allowed and will be monitored during the topic selection phase.

Project Scope and Requirements

Problem Formulation

- The optimization problem must incorporate at least:
  - **three (3) design variables**
  - **one (1) objective function**
  - **two (2) constraints**, which may be equality constraints, inequality constraints, or a combination of both
- The report must clearly define and explain:
  - The **design variables**, including their physical meaning, range, and units
  - The **objective function(s)**, including its purpose and relevance
  - The **constraints**, along with their engineering interpretation and necessity

Use of Engineering Software

- A **software tool must be utilized** to obtain or simulate the values of the objective function and/or constraints.
- The use of **low-fidelity tools** (e.g., MATLAB, Python-based models, ANSYS Student, OpenFOAM, SimScale) **is permitted** provided they sufficiently represent the engineering scenario.
- The modeling or simulation approach must be documented in the report.

Selection of Optimization Algorithm

- An **appropriate optimization algorithm** must be selected and implemented (e.g., linear programming, gradient-based methods, gradient-free methods, multi-objective optimization methods).
- The selection must be **justified** based on the characteristics of the formulated problem, such as the dimensionality, linearity, continuity, and complexity of the design space.
- The **settings and parameters** used in the optimization (e.g., population size, maximum iterations, convergence tolerance, penalty functions) must be specified and explained.

Result Analysis

The results must be critically analyzed to address **at least** the following:

- Whether the solution represents a **local or global optimum**
- Whether all constraints have been **satisfied**
- The **engineering feasibility and physical relevance** of the solution
- Any observed **sensitivity, trade-offs**, or notable behavior in the design space

Conclusion

- A clear and concise summary of findings, insights, and potential areas for improvement must be provided.

Individual Contributions

- Each member’s individual contribution to the project must be explicitly stated in the report.

Report and Presentation

Report Structure and Content

- The final report shall be submitted in PDF format and must include at least:
  - Cover Page: Title, Names and student IDs of group members
  - Abstract
  - 1. Introduction
  - 2. Problem Formulation
  - 3. Modeling and Software Tools
  - 4. Optimization Methodology
  - 5. Results and Discussion
  - 6. Conclusion and Future Work
  - 7. Individual Contributions
- Supplementary data, figures, codes, or screenshots

Presentation Requirement

- Each group is also required to deliver a formal presentation of their project.
- The presentation shall:
  - Be a maximum of 15 minutes in duration (including Q&A session)
  - Include a structured overview of the problem, methodology, results, and conclusions.
  - Be delivered using PowerPoint or PDF slides.
  - Reflect the contributions of all group members.
- The exact presentation schedule and format (in-person or virtual) will be communicated in due course.
- The presentation material shall be submitted in the form of PPTX or PDF format.