The Hong Kong University of Science and Technology

[Course Title] Numerical Methods in Engineering

[Course Code] MECH 4740

[No. of Credits] 3

[pre-/co-requisites] (MATH 1014 or MATH 1020 or MATH 1024) AND (COMP2021 or COMP1022P)

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Course Description

Numerical methods are at the core of modern engineering. Many real systems cannot be solved analytically, and reliable computation is often the only way to predict performance, explore designs, and make decisions from models and data. In the era of rapidly advancing computing and AI, engineers are expected not only to use simulation tools, but also to understand the numerical principles behind accuracy, stability, and efficiency. This course provides that foundation and connects it to real engineering practice in both academia and industry.

The course covers a broad range of essential topics for numerical solutions to engineering problems, including numerical error analysis, root finding, systems of linear algebraic equations, numerical differentiation and integration, and numerical methods for ordinary and partial differential equations. Optimization techniques are also introduced to connect numerical computation to engineering design. Throughout the course, students will learn both the theory behind each method and the approaches for effective implementation.

This course is intended for senior undergraduate students and early graduate students in engineering. It has three main objectives: (1) to teach the basic theories and fundamentals of numerical methods, (2) to help students gain skills to implement these methods for computer based solutions, and (3) to provide an environment where students can familiarize themselves with many today's popular commercial software systems, such as MATLAB or Python, and their use in solving real engineering problems.

The course includes two weekly lectures and one tutorial session. In addition to exams, students will complete a group final project where they can select a topic of interest, ranging from real world engineering problems to research oriented explorations.

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage]

Assessment Task	Contribution to Overall Course grade (%)
Homework	20%
Mid-Term	20%

Final Project	30%
Final Examination	30%

Required Texts and Materials

Textbook: *Numerical Methods for Engineers* by S.C. Chapra and R.P. Canale, 6th edition.

Lecture Notes.

[Optional] Additional Resources