

HONG KONG BAPTIST UNIVERSITY

COURSE OUTLINE

1. COURSE TITLE

Special Topics in Applied Mathematics I

2. COURSE CODE

MATH4665

3. NO. OF UNITS

3 Units

4. OFFERING DEPARTMENT

Department of Mathematics

5. PREREQUISITES

Prerequisite: Year 3 standing or above or consent of instructor

6. MEDIUM OF INSTRUCTION

English

7. AIMS & OBJECTIVES

The course aims to provide a general study to all students whose research fields are within the applied & computational mathematics and statistics. It covers some fundamental and important topics on linear algebra, optimization and analysis. Real-world applications will be discussed, such as image processing, machine learning algorithms, financial modeling, climate models, and more.

8. COURSE CONTENT

Sub-title: Advanced Numerical Methods & Algorithms

Topics

I. Linear Algebra

Examples of topics we may cover:

- A. Iterative Methods for Linear Systems
- B. Regression by Least Squares

II. Optimization

Examples of topics we may cover:

- A. Multivariable Calculus Background
- B. Optimality Condition
- C. Unconstrained and Constrained Optimization

III. Analysis

Examples of topics we may cover:

- A. Function Spaces
- B. Linear Operators
- C. Convergence and Compactness

References

1. J. W. Demmel, Applied Numerical Linear Algebra, SIAM, Philadelphia, 1997.
2. J. E. Dennis and R. B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM, Philadelphia, 1996.
3. D. Breit and F. Gmeineder, A Course on Function Spaces. I: Spaces of Continuous and Integrable Functions, Universitext, Springer Cham, 2026.
4. M. J. Schervish, Theory of Statistics, Springer Series in Statistics, Springer, New York, 1995.

Software

1. Matlab and other related matrix computation software

9. COURSE INTENDED LEARNING OUTCOMES (CILOs)

CILO	By the end of the course, students should be able to:
CILO 1	Apply numerical techniques learned from the chosen topics to solve related open-ended problems
CILO 2	Suggest professional research proposal to solve real-life problems
CILO 3	Explain the concept/theory in a research professional and non-expert
CILO 4	Effectively communicate with others regarding research findings

10. TEACHING & LEARNING ACTIVITIES (TLAs)

CILO alignment	Type of TLA
1.3	Lecture The instructor will present math applications to motivate students' interests and to introduce the topics of the course's materials. Basic concepts and algorithms will be introduced to consolidate students' background knowledge. Examples on numerical analysis will be given to illustrate finer details.

2,3,4	<p>In-class activities During classes, students have the opportunity to participate in activities of various forms, including discussions and presentation.</p> <p>For example, students are asked to present their research proposals. Other students may be asked to evaluate and question the presented research ideas as referees.</p>
1,2,3	<p>Student Orientated Case Study Students work individually in a self-proposed research project and prepare a research article with publishable standard. They shall present the work to their classmates and take part in discussing and trying to improve others' work via exchange of ideas. This allows students to develop their collaboration and communication skills.</p>

11. ASSESSMENT METHODS (AMs)

Type of Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
Written Assignments	30 %	1	<p>High-level questions, including open-ended problems and black box explorations in each chapter will be given.</p> <p>There will be at least 3 assignments. Each of them allows the instructor to keep track of how well the students master the math concept, computational skill, and numerical and analytical techniques covered during different stages of the course.</p>
Oral assessment	20 %	2,3	<p>Possible research directions will be given, and students are required to propose and present their own research proposal verbally without doing calculation.</p> <p>There will be 2 oral assessments. Each of them allows the students to know what they understand well and what they need to think more about in order to prepare a professional research proposal. It also allows the instructor to correct students' misconception and identify learning needs.</p>
Project	25 %	3	<p>Students work individually on the endorsed research proposal.</p> <p>The project allows the instructor to assess how well students perform in the following criteria.</p> <ul style="list-style-type: none"> □ 20% organization and motivation to sell the key

			<p>points of the paper</p> <ul style="list-style-type: none"> <input type="checkbox"/> 20% selecting good notation and giving appropriate amounts of details <input type="checkbox"/> 20% describe and analyze numerical results accurately <input type="checkbox"/> 20% Work readiness for submission <p>Professional typesetting in LaTeX is strongly recommended.</p>
Presentation	25 %	3,4	<p>Students will submit a poster presentation in a conference setting, and they are also required to take part in discussing and trying to improve others' projects/ multi-media presentation via exchange of ideas.</p> <p>The presentation allows the instructor to assess how well students perform in the following criteria.</p> <ul style="list-style-type: none"> <input type="checkbox"/> 20% clarity and effectiveness of poster <input type="checkbox"/> 40% audibility and liveliness of the presentation <input type="checkbox"/> 20% accuracy of mathematical content in Q&A <input type="checkbox"/> 20% ability to comment and give good suggestions to others' projects

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