The Hong Kong University of Science and Technology

UG Course Syllabus

Fall 2025-2026

Math 4052 **Partial Differential Equations**

Credits: 3

Pre-requisite: (MATH 2023/MATH 3043 and MMATH 2111/MATH 2121/MATH 2131/MATH 2350 and MATH 2350/MATH 2351/MATH 2352

Exclusion: NIL
Brief Information/synopsis:

Derivations of the Laplace equations, the wave equations and diffusion equation; Methods to solve equations: separation of variables, Fourier series and integrals and characteristics; maximum principles, Green's functions.

Lecture

Time: Tuesday and Thursday 15:00-16:20

Venue: Room 2463, Lift 25-26

Name: Yuanwei Qi

Email: warrenqi@ust.hk

Office Hours: by appointment in Room 3423

Tutorial

Time: Tuesday (10:30-11:20 am)

Venue: Room 6602, Lift 31-32

Name: Xiao SHI, Xiao/xshiau

Email: xshiau@ust.hk

Office Hours: to be announced in canvas

Course Description

Derivations of the Laplace equations, the wave equations and diffusion equation; Methods to solve equations: separation of variables, Fourier series and integrals and characteristics; maximum principles, Green's functions.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Recognize and use appropriately important technical terms and definitions.
2. Learn the background of basic partial differential equations, and their types.
3. Learn techniques to solve elementary partial differential equations.
4. Find particular solutions to well-posed problems to some PDEs and prove particular properties of solutions such as maximum Principle.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date (if applicable)
Homework	20%	Will be announced in Canvas
Midterm	25%	TBD
Final Exam	55%	TBD

Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework	ILO1, ILO2, ILO3, ILO4	The homework assesses students' ability of understanding the concepts and, the logic and method, distilling the abstract setting from examples, and applying the theory to other fields.
Midterm	ILO1, ILO2, ILO3, ILO4	The mid-term exam assesses students' ability of understanding the concepts and the logic, distilling the abstract setting from examples, and applying the theory to other fields.
Final Exam	ILO1, ILO2, ILO3, ILO4	The final exam assesses students' ability of understanding the concepts and the logic, distilling the abstract setting from examples, and applying the theory to other fields.

Grading Rubrics

Marks for each problem will be specified. Full marks will be awarded for completely correct answers. Partial credit will be given for answers that are on the right track but not fully complete.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and theories of functional analysis taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of partial differential equations.
B	Good Performance	The student has mastered most theories of functional analysis taught in the course, yet the understanding of some challenging concepts may not be deep enough for their applications on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic computational techniques of the subject but only in finite dimensions, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest computations.
F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest computations even in finite dimensions.

Course AI Policy

Students are allowed to consult any person (including the instructor, TA, classmates, friends outside HKUST) in any homework for ideas and hints, but are required to write up the solutions by themselves. You are required to **list the persons and references** you have consulted in every homework.

The use of ChatGPT or other generative AI is allowed, and they are regarded as “persons” you have consulted, and therefore must be listed in your homework.

However, please be warned that at the current stage of development of AI, the response to problems in advanced courses – especially those in pure mathematics – is not quite reliable. Students should be critical of the response generated by AI and do not blindly copy the generated responses to your homework.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include the wrong places. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

Students should submit each homework in form of a clearly written and scanned or a LaTeX-typed PDF on the Canvas system before the deadline. No late homework is accepted. Resubmission is allowed before the deadline.

Required Texts and Materials

(1) Partial Differential Equations: An Introduction, Walter A. Strauss, 2nd edition, John Wiley, Sons.

(2) Other reference: Partial Differential Equations by Fritz John. New York, NY : Springer New York : Imprint: Springer, 1971, which can be access at: https://lbdiscover.hkust.edu.hk/bib/991012682363103412

Keyword Syllabus:

PDEs in History, types of second order PDEs.

Characteristic curve method: Transport equation, first-order linear equations solved by characteristics, The wave equation in 1D, D'Alembert's formula, and Causality/ Energy

Boundary problems, separation method.

Fourier analysis, wave and heat(diffusion) equation with 1d bounded domain and boundary conditions.

Laplace's equation and fundamental solution, Harmonic functions, equivalence to Mean value property, Maximum principle and uniqueness of solutions.

Green function as integral kernel to solve Laplace equations, explicit formula of Green function on ball and half plane.

Concept of Delta function as Distributions, introduction to Green kernel of linear differential operators.

Heat equations and heat kernels, 1 D real line(unbounded) heat equation.

Advanced materials such as Minimum Principle for the Eigenvalues, Calculus of Variation

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.