Course Title: Mathematical Methods in Physics I

Course Code: PHYS2124

Credit Points: 3

Pre-requisite: MATH 2023 AND (MATH 2121 OR MATH 2131)

Exclusion: MATH 2350, MATH 2351, MATH 2352

Cross Campus Course Equivalence: AMAT 2020

Instructor:

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>   Office: Rm 4444

>   Office Hour: After lecture, Tue 3 – 4pm or by appointment at Rm 4444

Course Description

This course will cover most of the mathematical tools required for studying classical mechanics, electromagnetism, quantum mechanics and statistical mechanics. Key topics include complex numbers, vector analysis, Fourier series and transform, ordinary differential equations and series solutions.

Intended Learning Outcomes (ILO)

On successful completion of this course, students are expected to be able to:

By the end of the course, students are expected to:

1. Understand complex numbers

2. Be able to obtain a Fourier series of elementary functions.

3. Analyze a simple physical problem by modeling a physical system to a first/second order differential equation.

4. Visualize solutions of differential equations using directional fields

5. Understand and use various techniques to solve differential equations: Fourier series, Laplace transformation, series solution.

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.

Assessment	Contribution to Overall Course grade (%)	Due date
Homework**	5% (bonus)	Every other Tuesday, 11:59pm
Tests (2 Tests)*	25% x 2 = 50%	March 6 & April 15 (in-class)
Final Exam	50%	TBA

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

* Homework is assigned biweekly and students have an option to exclude one of the tests. If you choose to exclude a test score, the final exam score will be rescaled to 75% instead. It is by default that if one of your test scores is lower than your final exam score in a 100 point score, the lowest test score will be excluded and the final exam will be rescaled to 75%.

** The students are encouraged to submit the Homework. Additional 5% bonus, based on the homework score, will be added to the course grade.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework Tutorial Exercises Midterm Exam Final Exam	ILO 1 – 5	These tasks assess students' ability to apply various mathematical methods to solve physics problems involving the use of vectors, complex numbers Fourier series and ordinary differential equations. (ILO 1, 2, 3, 4, 5)

Grading Rubrics

All questions in the assessment tasks are graded based on correctness of the answers in a holistic scheme as follows.

Max. point of a short question/sub-question is 3 points.
Max. point of a long question without question is 9 points.

Point in Short Questions / sub-questions	Point in Long Questions without sub-questions	Performance
---	+1 Bonus	Bonus point for perfect solution presented in a logically coherent manner / signs of deep physics insight / creative approach to the problem / demonstration of good problem-solving skills.
3	7-9	Practically correct with only small careless mistakes that do not originate from conceptual misunderstanding, e.g., didn't carry over an overall factor of 2, correcting a sign error in the final answer by arguing what the sign should have been based on physical intuition
2	4-6	Showing clear understanding on the physics and/ or how to approach the problem but committed substantial mistakes, e.g., wrong overall sign opposing physical intuition, got all the physics right but screwed up badly on the math
1	1-3	Reasonable attempt but not quite correct, e.g., writing down some relevant equations without showing how they can be used to solve the problems, didn't proceed beyond the very first steps of solving the problem.
0	0	No sign of understanding (including no attempt)

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of the main subject matter, competence in problem-solving, and the ability to analyze and evaluate issues. Displays high motivation to learn.
C	Satisfactory Performance	Possesses adequate knowledge of core subject matter, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve learning goals.
D	Marginal Pass	Has threshold knowledge of core subject matter and potential to achieve key professional skills. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of the subject matter and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

*The final grade will be assessed using criterion-referencing and the difficulties of the assessment will be considered when determining the range of overall course grade in each final grade, such that the final grade reflects the criteria that students achieved in the course. Thus, the range of overall course grades of each final grade may vary semester to semester depending on the difficulties of the assessment, including homework, tutorial exercises and exams.

Course AI Policy

In this course, except for examinations, you are allowed to use generative artificial intelligence (AI) to aid you for learning purposes. However, you must give proper credit for any use of generative AI.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. 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

Submission of assessments including homework assignments and tutorial exercises will not be considered. Zero mark will be given for late submissions of the tasks.

Required Texts and Materials

Textbook: Mathematical Methods in the Physical Sciences 3rd ed. by Mary L. Boas
Online resources: Lecture Notes on Canvas

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.

Course Content

1. Review of Power Series

2. Complex Numbers

3. Fourier series

4. Ordinary Differential Equations

5. Laplace Transform

6. Series Solution

7. Simple partial differential equation