City University of Hong Kong
Course Syllabus

offered by Department of Physics
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	**Mathematical Methods for Scientists and Engineers**
Course Code:	**PHY6503**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**P6**
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**Nil**
Precursors: *(Course Code and Title)*	**MA2158 Linear Algebra and Calculus or equivalent**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**PHY8503 Mathematical Methods for Scientists and Engineers**

Part II Course Details

1. Abstract

This is a graduate course on mathematical methods for physicists and engineers. Topics that will be covered include: linear algebra, fourier series, integral transforms, infinite series, complex analysis, ordinary and partial differential equations, integral equations, group theory, tensor methods, probability.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Describe and apply common mathematical analysis methods employed by physicists.	40		✔	
2.	Execute mathematical analysis using both analytical and computational methods.	40	✔	✔	✔
3.	Demonstrate the capacity for self-directed learning on topics related to mathematical analysis methods.	20	✔		✔
		100%			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3				
Lecture	Explain key concepts of topics of the course	✔	✔					2
Small Class Activities	Explain some details of how some techniques are applied	✔	✔	✔				1
Assignments	Homework	✔	✔	✔				

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3					
Continuous Assessment: __50__%								
Coursework	✔	✔	✔				50%	Weekly assignments
Examination: 50% (duration: 2hrs)	✔	✔	✔				50%	
							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Coursework	1. Capacity for using knowledge of mathematical methods to solve physics problems 2. Demonstrate correct understanding of key concepts	Student completes all assignments, and demonstrates excellent understanding of the mathematical methods employed by physicists. Student can thoroughly identify which methods are applicable for a given analysis. Student is able to utilize computing algorithms necessary to perform analysis digitally. Student is able to present analysis results effectively via text and graphs.	Student completes at least 80% of assignments, and demonstrates understanding of the mathematical methods employed by physicists. Student can identify which methods are applicable for a given analysis. Student is able to utilize algorithms necessary to perform analysis digitally. Student is able to present analysis results via text and graphs	Student completes at least 70% of assignments, and shows some understanding of the mathematical methods employed by physicists. Student can usually identify which methods are applicable for a given analysis. Student is able to utilize simple algorithms to perform analysis digitally. Student can present results via text and graphs, but in a manner that may require some effort to interpret.	Student completes at least 60% of assignments, but can only demonstrate brief understanding of the mathematical methods employed by physicists. Student with guidance is able to identify which methods are applicable for a given analysis. Student is able to utilize simple algorithms to perform analysis digitally. Student presents results in a way that requires significant effort or further analysis to interpret.	Student completes less than 50% of assignments. Or, fails to accurately describe the mathematical methods employed by physicists. Student is not able to identify which methods are applicable for a given analysis. Student fails to utilize simple algorithms to perform analysis digitally. Student can't present results in a meaningful way.
2. Examination	1. Capacity for using knowledge of mathematical methods to solve physics problems 2. Demonstrate correct understanding of key concepts	Demonstrates excellent understanding of the mathematical methods employed by physicists. Student can thoroughly identify which methods are applicable for a given analysis.	Demonstrates understanding of the mathematical methods employed by physicists. Student can identify which methods are applicable for a given analysis.	Shows some understanding of the mathematical methods employed by physicists. Student can usually identify which methods are applicable for a given analysis.	Only demonstrate brief understanding of the mathematical methods employed by physicists. Student with guidance is able to identify which methods are applicable for a given analysis.	Fails to accurately describe the mathematical methods employed by physicists. Student is not able to identify which methods are applicable for a given analysis.

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Coursework	1. Capacity for using knowledge of mathematical methods to solve physics problems 2. Demonstrate correct understanding of key concepts	Student completes all assignments, and demonstrates excellent understanding of the mathematical methods employed by physicists. Student can thoroughly identify which methods are applicable for a given analysis. Student is able to utilize computing algorithms necessary to perform analysis digitally. Student is able to present analysis results effectively via text and graphs.	Student completes at least 80% of assignments, and demonstrates understanding of the mathematical methods employed by physicists. Student can identify which methods are applicable for a given analysis. Student is able to utilize algorithms necessary to perform analysis digitally. Student is able to present analysis results via text and graphs	Student completes at least 60% of assignments, but can only demonstrate brief understanding of the mathematical methods employed by physicists. Student with guidance is able to identify which methods are applicable for a given analysis. Student is able to utilize simple algorithms to perform analysis digitally. Student presents results in a way that requires significant effort or further analysis to interpret.	Student completes less than 50% of assignments. Or, fails to accurately describe the mathematical methods employed by physicists. Student is not able to identify which methods are applicable for a given analysis. Student fails to utilize simple algorithms to perform analysis digitally. Student can't present results in a meaningful way.
2. Examination	1. Capacity for using knowledge of mathematical methods to solve physics problems 2. Demonstrate correct understanding of key concepts	Demonstrates excellent understanding of the mathematical methods employed by physicists. Student can thoroughly identify which methods are applicable for a given analysis.	Demonstrates understanding of the mathematical methods employed by physicists. Student can identify which methods are applicable for a given analysis.	Only demonstrate brief understanding of the mathematical methods employed by physicists. Student with guidance is able to identify which methods are applicable for a given analysis.	Fails to accurately describe the mathematical methods employed by physicists. Student is not able to identify which methods are applicable for a given analysis.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- Probability and statistical analysis: distributions, generating functions, central limit theorems, stochastic processes
- Complex Variables: analytic functions, complex integrals, contour integration
- Fourier analysis: Fourier transforms, delta functions, power spectrum density
- Ordinary Differential Equations: exact and series solutions, special functions
- Partial Differential Equations: separation of variables, change of coordinates
- Computational methods: numerical methods, qualitative methods.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	D.A. McQuarrie Mathematical Methods for Scientists and Engineers

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)