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:	РНУ6503						
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	Discov	very-en	riched
		(if	curricu	ulum rel	lated
		applicable)	learnin	ng outco	omes
			(please	e tick	where
			approp	oriate)	
			A1	A2	A3
1.	Describe and apply common mathematical analysis methods	40		~	
	employed by physicists.			_	
2.	Execute mathematical analysis using both analytical and	40	✓	~	~
	computational methods.				
3.	Demonstrate the capacity for self-directed learning on topics	20	 Image: A set of the set of the		~
	related to mathematical analysis methods.				
		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/cro

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		
		1	2	3			applicable)
Lecture	Explain key concepts of topics of	<	<				2
	the course	-	-				
Small Class	Explain some details of how some	<	<	<			1
Activities	techniques are applied	-	-	-			
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:	~	~	<				50%	
2hrs)		-	•					
							100%	

5. Assessment Rubrics

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

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

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

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

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

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.)