# City University of Hong Kong Course Syllabus

# offered by Department of Physics with effect from Semester A 2022/23

Part I Course Overview	7
Course Title:	Mathematical Methods for Scientists and Engineers
Course Code:	PHY8503
Course Duration:	One Semester
Credit Units:	3
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: (Course Code and Title)	Nil
<b>Precursors</b> : (Course Code and Title)	MA2158 Linear Algebra and Calculus or equivalent
<b>Equivalent Courses:</b> (Course Code and Title)	Nil
Exclusive Courses: (Course Code and Title)	PHY6503 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)

No.	CILOs	Weighting*		ery-eni	
		(if	curricu	ılum rel	lated
		applicable)	learnin	g outco	omes
			(please	e tick	where
			approp	riate)	
			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 self-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. Teaching and Learning Activities (TLAs)

TLA	Brief Description	CILO No.			Hours/week (if		
		1	2	3	4		applicable)
Lecture	Explain key concepts of topics of the course	<b>'</b>	~				2
Small Class Activities	Explain some details of how some techniques are applied	•	~	/			1
Assignments	Homework	•	<b>/</b>	/			

# 4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.			Weighting*	Remarks	
	1	2	3	4		
Continuous Assessment:509	%					
Coursework	~	~	~		50%	Weekly assignments
Examination: 50% (duration: 2hrs)	~	~	~		50%	
	•		•	•	100%	

## 5. Assessment Rubrics

# Applicable to students admitted in Semester A 2022/23 and thereafter

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

problems	the mathematical	methods	the mathematical	methods
2. Demonstrate correct	methods employed	employed by	methods	employed by
understanding of key concepts	by physicists.	physicists.	employed by	physicists.
	Student can	Student can	physicists.	Student is not
	thoroughly identify	identify which	Student with	able to identify
	which methods are	methods are	guidance is able	which methods
	applicable for a	applicable for a	to identify which	are applicable for
	given analysis.	given analysis.	methods are	a given analysis.
			applicable for a	
			given analysis.	

# Applicable to students admitted before Semester A 2022/23

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

		and graphs.		effort to interpret.	or further analysis to interpret.	
2. Examination	1. Capacity for using	Demonstrates	Demonstrates	Shows some	Only demonstrate	Fails to accurately
2. Examination	knowledge of mathematical	excellent	understanding of	understanding of	brief	describe the
	<u> </u>		C	l C		
	methods to solve physics	understanding of	the mathematical	the mathematical	understanding of	mathematical
	problems	the mathematical	methods employed	methods employed	the mathematical	methods employed
	2. Demonstrate correct	methods employed	by physicists.	by physicists.	methods employed	by physicists.
	understanding of key concepts	by physicists.	Student can	Student can	by physicists.	Student is not able
		Student can	identify which	usually identify	Student with	to identify which
		thoroughly	methods are	which methods are	guidance is able to	methods are
		identify which	applicable for a	applicable for a	identify which	applicable for a
		methods are	given analysis.	given analysis.	methods are	given analysis.
		applicable for a			applicable for a	
		given analysis.			given analysis.	

## **Part III Other Information**

## 1. Keyword Syllabus

- 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

1.	D.A. McQuarrie Mathematical Methods for Scientists and Engineers	
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## 2.2 Additional Readings

1.	
2.	
3.	