Hong Kong Baptist University
Faculty of Science – Department of Physics

Title (Units): **PHYS 2017 MATHEMATICAL METHODS FOR PHYSICAL SCIENCES II (3,3,1)**

Course Aims: This course provides students with the necessary mathematical knowledge in preparation for studying further courses in physical sciences, such as Atomic & Nuclear Physics, Quantum Mechanics and Solid State Physics. It illustrates the use of mathematics in physical sciences context so that students can apply their math skills in a practical situation.

Pre-requisite: PHYS2016 Mathematical Methods for Physics Sciences I or consent of instructor.

Course Reviewed by: Prof. Chang-song Zhou, Dr. Wing Kee Mok and Prof. Shu Kong So

Course Intended Learning Outcomes (CILOs):

No.	Upon successful completion of this course, students should be able to:
1	Describe theory and methods of linear algebra, Fourier series and Fourier transform, and partial differential equations and their applications in physical problems.
2	Solve linear equations and perform basic matrix operations such as multiplication.
3	Obtain Fourier coefficients and Fourier series for periodic functions and perform Fourier transforms.
4	Apply the method of separation of variables to partial differential equations and solve boundary value problems for Laplace equations.

Teaching & Learning Activities (TLAs)

CILOs	**TLAs will include the following:**
1-4	● Students will learn the basic theory and methods and application of the methods to example problems by attending lectures, reviewing lecture notes and doing textbook reading assignments. ● Students will learn how to derive linear and differential equations for physical problems and how to apply the methods to solve the problems.
2-4	● Students will develop the skills of applying the methods through quizzes in tutorial classes, homework assignments, semester tests and course examination.

Hong Kong Baptist University
Faculty of Science – Department of Physics

Assessment Methods (AMs):

Type of Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
One 1-hour semester Test, Tutorial Assessment and Continuous Assessment	50%	1-4	One 1-hour Test, Tutorial Assessment and Continuous Assessment are designed to measure how well the students have learned the basic concepts, fundamental theory and methods of linear algebra, and Fourier series and transforms with application in a physical context.
Final Examination	50%	1-4	Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess the student's versatility in solving physically relevant problems in linear algebra, Fourier series and transform and partial differential equations.

Learning Outcomes and Weighting:

Content	CILO No.	Teaching (in hours)
I. Linear algebra	1, 2	12
II. Fourier series and Fourier transforms	1, 3	12
III. Partial differential equations and series solution to differential equations	1, 4	12

Textbook: Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, 2005.

References:

1. D.A. McQuarrie, Mathematical Methods for Scientists and Engineers, University Science Books, 2003.
2. G. Arfken and H.J. Weber, Mathematical Methods for Physicists, 6th Ed., Academic Press, 2005.
3. K.F. Riley, M.P. Hobson and S.J. Bence, Mathematical Methods for Physics and Engineering, 3rd Ed., Cambridge University Press, 2006.
4. P. Dennery and A. Krzywicki, Mathematics for Physicists, Dover, 1996.

Hong Kong Baptist University
Faculty of Science – Department of Physics

Course Content in Outline:

	Topic	**Hours**
I.	Linear algebra	12
	A. Linear equations: row reduction, Cramer's rule	
	B. Matrix and determinant	
	C. Matrix operation, eigenvalues and eigenvectors	
	D. Linear vector space	
II.	Fourier series and Fourier transforms	12
	A. Periodic functions and their Fourier series representations.	
	B. Fourier transforms with applications.	
	C. The Dirac delta function.	
III.	Partial differential equations	12
	A. Laplace's equation, Poisson's equation, the diffusion equation and wave equations.	
	B. The method of separation of variables.	
	C. The Laplace equation in rectangular, spherical and cylindrical coordinates.	
	D. Series solutions to differential equations	
	C. Legendre polynomials and spherical harmonics.	