Hong Kong Baptist University
Faculty of Science - Department of Physics

Title (Units): **PHYS 2016 MATHEMATICAL METHODS FOR PHYSICAL SCIENCES I (3, 3, 1)**

Course Aims: This course provides students with the necessary mathematical knowledge in preparation for studying further courses in mathematical methods for Physics II and other physical sciences. It illustrates the use of mathematics in physical sciences context so that students can apply their math skills in a practical situation.

Pre-requisite: Year 2 standing or consent of instructor.

Course Reviewed by: Prof. Changsong 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 series expansion, complex numbers, vector analysis and ordinary differential equations.
2	Expand functions into power series.
3	Apply methods of differentiation and integration.
4	Apply vector analysis and line integral.
5	Solve first-order and second-order differential equations to get general solutions.

Teaching & Learning Activities (TLAs)

CILOs	**TLAs will include the following:**
1-6	● 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 differential equations for physical problems and how to apply the methods to solve the problems.
2-6	● Students will develop the skills of applying the methods through quizzes in tutorial classes, homework assignments, semester tests and course examination.

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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%	1-5	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 series and complex numbers, calculus, vector analysis and ordinary differential equations.
Final Examination	50%	1-5	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 the learned topics.

Learning Outcomes and Weighting:

Content	CILO No.	Teaching (in hours)
I. Power series expansion of functions	1, 2	6
II. Differentiation and integration	1, 3	10
III. Vector and vector analysis	1, 4	10
IV. Ordinary differential equations	1, 5	10

Textbook:
1. Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, 2005.
2. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus, 11th Ed., Wiley 2016.

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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.

Course Content in Outline:

	Topic	**Hours**
I.	Series expansion of real and complex functions	6
	A. Power series and expanding functions in power series	
	B. Real and imaginary part of complex number and complex plane	
	C. Complex power series and Euler's formula	
II.	Calculus	10
	A. Derivatives	
	B. Differentiation rules	
	C. Indefinite integral	
	D. Definite Integral	
III.	Vector analysis	10
	A. Vector and vector multiplication.	
	B. Differentiation of vectors, directional derivative and line and surface integrals.	
	C. Green's theorem in the plane.	
	D. The divergence and the divergence theorem.	
	E. The curl and Stokes' theorem.	
IV.	Ordinary differential equations	10
	A. Initial and boundary value problems in physics.	
	B. Separable equations and first order linear differential equations.	
	C. Second order linear differential equations with constant coefficients.	