Hong Kong Baptist University
Faculty of Science – Department of Physics

Title (Units): **PHYS 2006 ELECTRICITY AND MAGNETISM (3,3,1)**

Course Aims: This course covers the basic concepts in classical electromagnetism, as to prepare the students for studies in physics and energy science. Topics include electrostatics, circuits, induction, motors, generators, alternating currents, transformers, electromagnetic waves and optics.

Pre-requisite: PHYS 1005 Introduction to Green Energy or PHYS1006 Introduction to Physics or consent of instructor.

Course Reviewed by: Dr. Jack T.F. Ng and Dr. Kin-Yiu Wong

Course Intended Learning Outcomes (CILOs):

No.	Upon successful completion of this course, students should be able to:
1	Describe and explain the fundamental principles of electromagnetism including electrostatics, electric circuits, magnetism, induction, generation of electricity, alternating currents, electromagnetic oscillations, Maxwell's equations, electromagnetic waves and optics.
2	Illustrate the principles of electromagnetism used in energy and other areas of technologies such as transformers, motors, generators, electric power transmission and solar concentrators.
3	Formulate strategy and apply appropriate techniques to solve physical problems in electricity and magnetism.

Teaching & Learning Activities (TLAs)

CILOs	TLAs will include the following:
1-2	In-class demonstrations, videos and online resources will be used to introduce the fundamental principles of electricity and magnetism.
1-3	Lecture, homework and class discussion will address the desired learning outcomes by emphasizing the key concepts.

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Teaching & Learning Activities (TLAs)

CILOs	TLAs will include the following:
1-3	Students working in small groups solve problems involving one or more principles of electromagnetism such as determining the field or potential of a given charge distribution. They will learn how to analyse the given problem and evaluate the technique that should be used for solving it. Moreover, they will also learn to apply the theory in new physical contexts and obtain correct analytical and numerical results.
2-3	Students may be required to construct a simple electric motor from a permanent magnet and copper coil. The way to understand and designing their motor train students with analytical and problem solving skills.

Assessment Methods (AMs):

Type of Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
Assignments	20%	1-3	Assignments are designed to measure students' understanding of the basic electromagnetic theory and to enhance their analytical skills.
Mid-term Test	30%	1-3	This test aims to measure students' ability to solve problems that relate to basic concepts in electromagnetism. It also serves to provide some feedback to the instructor and students.
Final Examination	50%	1-3	Students will solve a set of problems to show how far they have achieved their intended learning outcomes.

Learning Outcomes and Weighting:

Content	CILO No.	Teaching (in hours)
I. Electrostatics	1-3	10
II. Magnetism	1-3	10
III. Maxwell Equations and Electromagnetic Waves	1-3	10
IV. Optics	1-3	6

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Textbook: R.A. Serway and J.W. Jewett, Physics for Scientists and Engineers, 9th Ed., Brooks Cole, 2014.

References:
1. D. Halliday, R. Resnick and K.S. Krane, Physics, Vol. 2, 5th Ed., Wiley, 2002.
2. R.D. Knight, Physics for Scientists and Engineers: A Strategic Approach, 2nd Ed., Addison Wesley, 2007.
3. R.P. Feynman, R.B. Leighton and M. Sands, The Feynman Lectures on Physics, The Definitive Edition Volume 1 and 2, 2nd Ed., Addison-Wesley, 2005.
4. H.D. Young, R.A. Freeman and L. Ford, University Physics with Modern Physics, 12th Ed., Addison Wesley, 2007.

Course Content in Outline:

	Topic	**Hours**
I.	Electrostatics	10
	A. Coulomb's law	
	B. Electric field and Gauss's law	
	C. Electric potential, work and energy	
	D. Conductors, capacitors and dielectrics	
	E. DC circuits	
II.	Magnetism	10
	A. Magnetic fields	
	B. The Biot-Savart law and Ampere's law	
	C. Magnetic properties of matter	
	D. Faraday's law and inductance	
	E. Motors and generators	
	F. Electromagnetic oscillations and AC circuits	
	G. Transformers and power transmission	

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III.	Maxwell's Equations and Electromagnetic Waves	10
	A. Displacement current	
	B. Maxwell's equations	
	C. Electromagnetic waves	
	D. Poynting vector and energy transport	
	E. Momentum and radiation pressure	
IV.	Optics	6
	A. Geometric optics	
	B. Solar concentrators	
	C. Interference of light waves	
	D. Diffraction gratings	
	E. Diffraction of X-rays by crystals	