Hong Kong Baptist University
Faculty of Science – Department of Physics

Title (Units): **PHYS 2025 RENEWABLE ENERGY SOURCES AND TECHNOLOGIES I (3,3,1)**

Course Aims: This course explores the current practice and emerging technologies in renewable energy and its energy storage, distribution and efficient energy usage. Topics on novel technologies such as wind energy, biomass energy, high power density rechargeable batteries, and non-hydrogen based fuel cells will be discussed.

Pre-requisites: Year 2 standing or consent of instructor

Course Reviewed by: Dr. Z.F. Huang and Dr. Junxue Fu

Course Intended Learning Outcomes (CILOs):

No.	Upon successful completion of this course, students should be able to:
1	Identify a broad knowledge base in various technologies of renewable energy and its storage.
2	Explain the theory of batteries and fuel cells and in particular, high power density rechargeable batteries and non-hydrogen based fuel cells.
3	Explain the theory of electrical power transmission, in particular, the loss mechanism and the state-of-the-art solutions in current technology.
4	Evaluate various energy consumption patterns and analyze conservation schemes including thermal insulation, circulation, radiation shielding, reflection, etc. and the physical principles behind these practices.
5	Design simple energy conservation scheme and analyze the performance.

Teaching & Learning Activities (TLAs)

CILOs	TLAs will include the following:
1-4	Lectures will highlight the technology of various energy storage, distribution and conservation processes.
3	Using examples, power transmission requirements and improvements will be explored.
2, 5	Case studies to look at emerging renewable liquid fuel cells.
4, 5	Demonstrations of energy conservation and energy storage.

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Assessment Methods (AMs):

No.	Assessment Methods	Weighting	CILOs to be addressed	Remarks
1	Semester test, tutorial assignments and Continuous Assessment	50%	1-4	Test and assignments are designed to guide the learning process of students on how to express known facts in the form of equations. From the known data the students can then learn the basic skills in problem solving.
2	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 problems that can be used in a wide range of problems.

Learning Outcomes and Weighting:

Content	CILO No.	Teaching (in hours)
I. Energy overview	1-4	1
II. Wind energy	1	8
III. Bioenergy	1	6
IV. Batteries and fuel cells	1, 2, 5	15
V. Energy transmission technology	3, 4	3
VI. Special topics	1	3

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Textbook:

- Supramaniam Srinivasan, *Fuel Cells: From Fundamentals to Applications*, (Springer Publisher, 2010)
- Ralph Zito, *Energy Storage: A New Approach* (John Wiley & Sons, and Scrivener Publishing, 2010)
- Clive Beggs, *Energy: Management, Supply and Conservation* (Elsevier, 2009)

References:

- Shin-ichi Inage, *Prospects for Large Scale Energy Storage in Decarbonized Power Grids* (International Energy Agency, 2009)
- H. A. Kiehne, Ed., *Battery Technology Handbook, 2nd Ed* (Marcel Dekker, 2003)
- Mike Montoya, *Green Building Fundamentals* (Prentice Hall, 2010)
- Frank Kreith and D. Yogi Goswami, Eds., *Energy Management and Conservation Handbook*, (CRC press, 2008)
- W.C. Turner and S. Doty, *Energy Management Handbook*, 7th ed., (Fairmount Press 2009)
- Alan Vertes et al, Ed.: *Biomass to Biofuels* (John-Wiley and Sons, 2010)
- Winfred Stieber: *Wind Energy Systems for Electric Power Generation* (Springer, 2008)

Course Content in Outline:

	Topic	**Hours**
I	Energy overview	1
	From generation to consumption	
	Renewable versus nonrenewable	
	Heat engines and turbines	
	Trends in energy development	
II	Wind energy	8
	A. Aerodynamics of wind turbine	
	B. Dynamics and statistics of wind sources	
	C. Environmental impact, system performance and cost analysis	
III	Bioenergy	6
	A. Biomass combustion	
	B. Biomass to gaseous biofuel conversion by heating and by anaerobic digestion	
	C. Biomass to liquid biofuel conversion via fermentation	
	D. Economic and environmental impacts	

	Topic	**Hours**
IV	Batteries and fuel cells	15
	A. The science of electrodes and electrolytes	
	B. The technology of batteries and rechargeable batteries	
	C. Fuel cell science and technology	
	D. Hydrogen based energy storage and conversion	
V	Energy transmission technology	3
	A. Grids	
	B. Loss mechanisms	
	C. The physics of reducing transmission loss	
	D. Power factor	
VI	Special topics (Examples include high power density rechargeable batteries, non-hydrogen based fuel cells, smart energy management, etc.)	3