Form 2B

REVISED on
2 May 2014

City University of Hong Kong

Information on a Course
offered by the Department of Physics and Materials Science
with effect from Semester A 2014 / 2015

Part I

Course Title: Energy Materials for the Current Century

Course Code: AP6176

Course Duration: One semester

No of Credit Units: 3

Level: P6

Medium of Instruction: English

Prerequisites: Nil

Precursors: Nil

Equivalent Courses: Nil

Exclusive Courses: AP4176 Energy Materials for the Current Century
AP8176 Energy Materials for the Current Century

Part II

1. Course Aims:

Energy has become a large societal issue due to the current reliance on non-renewable energy resources and their negative impact on the environment. Therefore, there is great interest in clean and renewable energy resources that would impact the globe in the near future. This course aims to introduce materials that revolutionize the current world with various energy options. The materials that control the performance of various energy sources such as photovoltaic devices, fuel cells, thermo-electric devices, and artificial photosynthesis are explored. In addition, materials for energy storage such as various types of batteries and super capacitors will be discussed.

2. Course Intended Learning Outcomes (CILOs)

(state what the student is expected to be able to do at the end of the course according to a given standard of performance)

Upon successful completion of this course, students should be able to:

No	CILOs	Level of Importance
1	Describe the material design and relate to photovoltaic device properties	2
2	Analyse the material design and explain causes on fuel cell properties	2
3	Relate the material design with thermoelectric device properties	2
4	Generate material design and application on photosynthesis	2
5	Identify and reflect the material design on energy storage devices	2

Remarks: 1 is the least importance

3. Teaching and Learning Activities (TLAs)[3]

(designed to facilitate students' achievement of the CILOs)

TLAs	Lectures	Tutorials[1]	Individual presentation	Total no of hours
CILO 1	5	1	2	8
CILO 2	5	1	2	8
CILO 3	5	1	2	8
CILO 4	5	1	2	8
CILO 5	5	1	2	8
Total (hrs)	25	5	10	40

1. In tutorial classes, students will be required to present and discuss on assigned topics. In helping students to solve numerical assignment problems, one hour of office hour will be assigned so that a Teaching Assistant will be available to answer questions.
2. Students will be asked to study and submit written reviews on assigned journal articles. In addition, students understanding on the assigned journal articles will be tested in the final examination paper.
3. On top of the hours listed in the TLA Table, students are expected to spend additional hours on the lecture notes, textbooks, etc.
4. Assignment work based on advanced materials for energy applications and students need to find materials on their own. This will be an individual assignment and presentations required at the end

4. Assessment Tasks/Activities
(*designed to assess how well the students achieve the CILOs*)

ATs	Exam[1]	Tutorials[2]	Individual presentation	Total (%)
CILO 1	10	2	8	20
CILO 2	10	2	8	20
CILO 3	10	2	8	20
CILO 4	10	2	8	20
CILO 5	10	2	8	20
Total (%)	50	10	40	100

1. The examination duration is 2 hours. Percentage of coursework, examination, etc: 50% by coursework; 50% by exam. To pass the course, students need to achieve at least 30% in the examination.
2. Tutorial mark is based on student's performance in tutorial class.

5. Grading of Student Achievement: Refer to Grading of Courses in the Academic Regulations for Taught Postgraduate Degrees.

The grading is assigned based on students' performance in assessment tasks/activities.

Grade A
The student completes all assessment tasks/activities and the work demonstrates excellent understanding of the scientific principles and the working mechanisms. He/she can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems. The student's work shows strong evidence of original thinking, supported by a variety of properly documented information sources other than taught materials. He/she is able to communicate ideas effectively and persuasively via written texts and/or oral presentation.

Grade B
The student completes all assessment tasks/activities and can describe and explain the scientific principles. He/she provides a detailed evaluation of how the principles are applied to science and technology for solving physics and engineering problems. He/she demonstrates an ability to integrate taught concepts, analytical techniques and applications via clear oral and/or written communication.

Grade C
The student completes all assessment tasks/activities and can describe and explain some scientific principles. He/she provides simple but accurate evaluations of how the principles are applied to science and technology for solving physics and engineering problems. He/she can communicate ideas clearly in written texts and/or in oral presentations.

Grade D
The student completes all assessment tasks/activities but can only briefly describe some scientific principles. Only some of the analysis is appropriate to show how the principles are applied to science and technology for solving physics and engineering problems. He/she can communicate simple ideas in writing and/or orally.

Grade F

The student fails to complete all assessment tasks/activities and/or cannot accurately describe and explain the scientific principles. He/she fails to identify and explain how the principles are applied to science and technology for solving physics and engineering problems objectively or systematically. He/she is weak in communicating ideas and/or the student's work shows evidence of plagiarism.

Part III

Keyword Syllabus:
Photovoltaic devices

- Physical properties of photovoltaic materials (light absorption and charge transport properties)
- Electrochemical devices and materials, e.g. dye sensitised solar cells

Fuel cells

- Proton transport materials
- Redox catalysts
- Applications of fuel cells

Thermoelectric (TE) devices

- Low thermal conductivity and high electrical conductivity TE materials
- Figure of merit

Photosynthesis

- Hydrogen Catalysts
- Water-oxidizing catalysts
- Photosensitizers
- Photocatalytic water splitting

Energy storage devices

- Super capacitors
- Batteries
- Smart grid

Recommended Reading:
Text Book:

Next Generation Photovoltaics: High Efficiency Through Full Spectrum Utilization - by A Marti, Antonio Luque, Institute of Physics (Great Britain), 2004

Organic Photovoltaics: Mechanism, Materials, and Devices
by Sam-Shajing Sun, Niyazi Serdar Sariciftci
Published by CRC Press, 2005

The Materials Science of Semiconductors
By Angus Rockett
Edition: illustrated
Published by Springer, 2007

Journal:
Nature Materials, Nature Photonics, Advanced Materials, American Chemical Society Journals, American Institute of Physics Journals and Elsevier Journals.