# City University of Hong Kong
# Course Syllabus

## offered by School of Energy and Environment
## with effect from Semester A 2019/20

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### Part I Course Overview

| | |
|---|---|
| **Course Title:** | Emerging Energy Technologies |
| **Course Code**: | SEE8125 |
| **Course Duration:** | One semester |
| **Credit Units**: | 3 |
| **Level**: | R8 |
| **Medium of Instruction:** | English |
| **Medium of Assessment:** | English |
| **Prerequisites**: *(Course Code and Title)* | Nil |
| **Precursors**: *(Course Code and Title)* | Nil |
| **Equivalent Courses**: *(Course Code and Title)* | SEE6118 Emerging Energy Technologies |
| **Exclusive Courses**: *(Course Code and Title)* | Nil |

**Part II Course Details**

**1. Abstract**

This course aims to provide students with the fundamental knowledge on the emerging energy technologies. This includes technologies that are expected to be the next state-of-the-art in the near future, from innovative clean energy conversion to energy storage. The acquired knowledge shall equip students for the rapidly evolving energy frontiers, and serve as a common ground for potential innovation in these technologies.

**2. Course Intended Learning Outcomes (CILOs)**

| No. | CILOs | Weighting | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|---|---|---|---|---|---|
| | | | *A1* | *A2* | *A3* |
| 1. | Describe basic principles in the conversion of fossil fuel (coal and natural gas) to ultraclean fuel, as well as their importance in the future energy equations; describe the process of carbon capture and storage and its importance in the integration of fossil fuel | 20% | ☑ | ☑ | |
| 2. | Describe the various means of solar energy conversion from first to third generation photovoltaic solar cells, and photoelectrochemical conversion; describe the working principles of different types of fuel cells. | 30% | ☑ | ☑ | ☑ |
| 3. | Describe the principles of energy storage through lithium ion batteries and supercapacitors, and their advantages; describe the principles of hydrogen storage such as metal hydrides and carbon nanotubes | 30% | ☑ | ☑ | |
| 4. | Apply the principles to evaluate the performances and challenges in various technologies. | 20% | | ☑ | |
| | | 100% | | | |

*A1:* *Attitude*
*Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.*

*A2:* *Ability*
*Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.*

A3: *Accomplishments*
*Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.*

## 3. Teaching and Learning Activities (TLAs)

| TLA | Brief Description | CILO No. | | | | | | Hours/week (if applicable) |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | | | |
| Lecture | Regular lectures to enrich students with the required science fundamentals for the applications of emerging technologies in energy conversion and storage | ☑ | ☑ | ☑ | | | | 2 hours/week |
| Tutorial | Mathematical-based in-class exercise to consolidate the skills of students in designing energy systems based on emerging technologies | | ☑ | ☑ | ☑ | | | 1 hour/week |
| Topical Workgroup | In-depth understanding of selected technologies by problem-solving | | ☑ | ☑ | ☑ | | | 2 hours/week |
| Presentation | General presentation to share research findings with classmates | | ☑ | ☑ | | | | |

## 4. Assessment Tasks/Activities (ATs)

| Assessment Tasks/Activities | CILO No. | | | | | | Weighting | Remarks |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | | | | |
| Continuous Assessment: __100__% | | | | | | | | |
| Assignment | | | ☑ | ☑ | | | 85% | |
| Oral presentation | ☑ | ☑ | ☑ | ☑ | | | 15% | |
| Examination: _0___% (duration: NA) | | | | | | | | |
| | | | | | | | 100% | |

To pass a course, a student must do ALL of the following:

1. obtain at least 30% of the total marks allocated towards coursework (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
2. obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3. meet the criteria listed in the section on Assessment Rubrics.

## 5. Assessment Rubrics

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B, B-) | Fair (C+, C, C-) | Marginal (D) | Failure (F) |
|---|---|---|---|---|---|---|
| 1. Assignment | Ability to apply mathematical skills in designing energy storage and conversion systems based on emerging technologies | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 2. Oral presentation | Ability to convey research findings orally in a convincing and systematic manner | High | Significant | Moderate | Basic | Not even reaching marginal levels |

## Part III  Other Information

### 1. Keyword Syllabus

**Ultraclean fossil fuel conversion:**
- Gas-to-liquid conversion
- Clean coal technologies
- Carbon capture and storage

**Energy conversion:**
- First, second and third generation solar cells
- Photoelectrochemical conversion
- Non-photovoltaic solar fuels
- Hydrogen fuel cells, direct methanol fuel cells, solid oxide fuel cells

**Energy Storage:**
- Lithium-ion batteries
- Rechargeable (non-lithium) batteries
- Flow batteries
- Supercapacitor
- Hydrogen storage

**Other smart energy technologies:**
- Advanced electric motors

### 2. Reading List
### 2.1 Compulsory Readings

| | |
|---|---|
| 1. | Raimondi, F., Scherer, G. G., Kotz, R., Wokaun, A. Nanoparticles in energy technology: Examples from electrochemistry and catalysis, *Angew. Chem. Int. Ed.* **2005**, *44*, 2190. |
| 2. | Somorjai, G. A., Frei, H., Park, J. Y. Advancing the frontiers in nanocatalysis, biointerfaces and renewable energy conversion by innovations of surface techniques, *J. Am. Chem. Soc.* **2009**, *131*, 16589. |
| 3. | Kamat, P. V. Meeting the clean energy demand. Nanostructure architectures for solar energy conversion, *J. Phys. Chem. C*, **2007**, *111*, 2834. |
| 4. | Winter, M., Brodd, R. J. What are batteries, fuel cells, and supercapacitors? *Chem. Rev.* **2004**, *104*, 4245. |

### 2.2 Additional Readings

Nil