Form 2B

City University of Hong Kong

Information on a Course
offered by Department of Biology and Chemistry
with effect from Semester B in 2013 / 2014

Part I

Course Title:	Sustainable and Green Chemistry
Course Code:	BCH6117
Course Duration:	1 Semester
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Prerequisites:	Nil
Precursors:	Nil
Equivalent Courses:	Nil
Exclusive Courses:	Nil

Part II

Course Aims:

The course teaches the most important concepts and tools of green chemistry that can be used to make future products, processes, and technologies sustainable. The context of green chemistry within scientific discovery and global impact will be addressed in order to provide understanding and appreciation of the students to relevant history and background from which green chemistry is developed. The principles and concepts of green chemistry will then be presented utilizing a framework that has been successfully implemented in classes, seminars, symposia and workshops in countries around the world. Following the thorough presentation of the theoretical basis of green chemistry, there will be examples covering the application of the concepts to various areas.

Course Intended Learning Outcomes (CILOs)

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

No.	CILOs	Weighting
1.	Describe sustainability, population, ethics, history of chemistry and chemical industry, accidents, regulation, image, case studies, risks, and the 12 principles of green chemistry.	15%
2.	Evaluate the advantages and disadvantages of energy generation, transportation, and storage: conventional, biofuels, solar, wind, water, geothermal, hydrogen, fuel cells, batteries.	25%
3.	Describe and compare fossil resources as well as renewables including carbohydrates, lignin, bio-oils, and carbon dioxide. Compare and contrast the advantages and disadvantages of alternative media including water, fluorous and ionic liquids, supercritical media, and extended liquids.	25%
4.	Compare conventional and green synthesis (by using solvent free reactions, microwave, cavitation, photochemistry, membranes, and micro-reactors). Evaluate the advantages and disadvantages of homogeneous, heterogeneous, and biocatalysis.	25%
5.	Describe the chemistry of reusable chemicals and materials.	10%

Teaching and learning Activities (TLAs)

(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)

ILO No	TLAs	Hours/week (if applicable)
CILO 1	The evolution of sustainability will be described. Examples for the negative effect of chemicals will be demonstrated. The 12 principles will be demonstrated. Students will calculate E-factor and atom economy of different type of reactions.	
CILO 2	Debate will be used to demonstrate the advantages and disadvantages of different energy options.	
CILO 3	Use of videos to illustrate the advantages and disadvantages of different resources and various solvents.	
CILO 4	Life-cycle analysis of green syntheses. Illustration of the advantages and disadvantages of different catalytic systems and reusable chemicals and materials.	
CILO 1-5	Tutorial activities including short lectures and discussions.	

Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

ILO No	Type of assessment tasks/activities	Weighting (if applicable)	Remarks
CILOS 1 - 5	Recollection test will be done at the end of each class to monitor the attention level.	10%	
CILO 2	Group presentations to demonstrate the advantages and disadvantages of different green energy options.	10%	
CILOS 3-5	10 minutes long individual presentations on the applications of alternative media, catalysis, and reusable chemicals and materials.	20%	

Starting from Semester B, 2002-03, students must satisfy the following "Minimum Passing Requirement" for BCH courses: *"A minimum of 30% in coursework as well as in examination, in addition to a minimum of 40% in coursework and examination taken together".*

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

Grading will be based on students' performance in assessment tasks and activities. Allocation of marks will be as follows: (1) a recollection test with five questions or statements at the end of lectures to monitor the attention level, 10%; (2) Group presentations to demonstrate some of the 12 principles of green chemistry - the presenting groups will be selected by drawing, 10%; (3) a mini-symposium with 10 minutes long individual presentations on the applications of alternative media and catalysis will be organized, 20%; (4) examination (3 hrs) 60%.

The table delineate the assessment weighting for each CILO

<table>
<tr><th>ILO No</th><th>Recollection Tests</th><th>Group Presentations</th><th>Individual Presentations</th><th>Examination</th><th>Total</th></tr>
<tr><td>CILO 1</td><td rowspan="5">10%</td><td></td><td></td><td rowspan="5">60%</td><td rowspan="5">100%</td></tr>
<tr><td>CILO 2</td><td>10%</td><td></td></tr>
<tr><td>CILO 3</td><td></td><td rowspan="3">20%</td></tr>
<tr><td>CILO 4</td><td></td></tr>
<tr><td>CILO 5</td><td></td></tr>
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Part III

Keyword Syllabus

Accidents, Algae, Aqueous, Atom economy
Batteries, Biodiesel, Bioethanol, Biofuels, Bio-inspired, Biomass
Carbohydrates, Carbon Dioxide, Catalysis, Cavitation, Chemicals, Chemofobia
Environmental factor, Enzymes, Ethics, Extended liquids
Fluorous, Fuel cells
Geothermal energy, Glass, Global warming, Green chemistry
Heterogeneous, Homogeneous, Hydrogen
Image, Ionic liquids
Lignin
Membranes, Metals, Micro-reactors, Microwave, MTBE
Organic, Ozone hole
Photochemistry, Plastics, Population, Pollution, Prevention, Principles
Regulations, Real time monitoring, Recycling, Risk, Rubber
Solar energy, Sonocation, Super critical media, Sustainability, Sustainable developments
Toxicity
Unleaded gasoline
Water, Wind energy
Zeolites

Recommended Reading

Text

Anastas, P. T. and Warner, J. C. *Green Chemistry*, Oxford University Press, Oxford, 1998

Review

Horváth, I. T. and Anastas, P. T., Innovations and Green Chemistry, *Chemical Reviews* **2007**, *107*, 2169.

Online Resources

Green Chemistry, Department of Chemistry, University of Oregon,
http://greenchem.uoregon.edu/

Greening Across the Chemistry Curriculum, Chemistry Department, University of Scranton, Scranton, PA 18510, USA
http://academic.scranton.edu/faculty/CANNM1/dreyfusmodules.html

Teaching pattern:

Duration of course: 1 semester
Suggested lecture/tutorial/laboratory mix:
Lectures: 26H
Tutorials: 13H