APPROVED

The University Of Toledo

New Graduate Course Proposal

* denotes required fields

1. College*: Coll Nat Sci and Mathematics

   Department*: Chemistry

2. Contact Person*: Mark Mason Phone: 530-1532 (xxx - xxxx) Email: mark.mason5@utoledo.edu

3. Alpha/Numeric Code (Subject area - number)*: CHEM - 6200

4. Proposed title*: Green Chemistry

   Proposed effective term*: 201340 (e.g. 201140 for 2011 Fall)

5. Is the course cross-listed with another academic unit? ○ Yes ◉ No

   Approval of other academic unit (signature and title)

   Is the course offered at more than one level? ○ Yes ◉ No

   If yes, an undergraduate course proposal form must also be submitted. If the undergraduate course is new, complete the New Undergraduate Course Proposal; if the undergraduate course is existing, submit an Undergraduate Course Modification Proposal.

6. Credit hours*: Fixed: 3 or Variable: to

7. Delivery Mode:

	Primary*	Secondary	Tertiary
a. Activity Type *	Lecture	--SelectType--	--SelectType--
b. Minimum Credit Hours *	3		
Maximum Credit Hours *	3		

Date Added: 11-26-13
Council Approved: 1.21.14
To Provost: 2.7.14

c. Weekly Contact Hours * 3

8. Terms offered: ☑ Fall ☐ Spring ☐ Summer

Years offered: ◉ **Every Year** ○ **Alternate Years**

9. Are students permitted to register for more than one section during a term? ◉ No ○ Yes

May the courses be repeated for credit? ◉ No ○ Yes Maximum Hours

10. Grading System*:
- ◉ Normal Grading (A-F, PS/NC, PR, I)
- ○ Passing Grade/No Credit (A-C, NC)
- ○ Credit/No Credit
- ○ Grade Only (A-F, PR, I)
- ○ Audit Only
- ○ No Grade

11. Prerequisites (must be taken **before**): i.e. C or higher in (BIOE 4500 or BIOE 5500) and C or higher in MATH 4200

CHEM 2420, Organic Chemistry II

○ PIN (Permisson From Instructor) ○ PDP (Permission From Department)

Co-requisites (must be taken **together**):

12. Catalog Description* (**75 words Maximum**)

Advanced topics in green chemistry, including industrial applications, atom economy, safer solvent substitutions, alternatives assessment, green metrics (PMI, E-factor), basic life cycle analysis, and an introduction to chemical toxicology

13. Attach a syllabus and an electronic copy of a complete outline of the major topics covered. Click here for template.

File Type	View File

Syllabus	View

Course Approval:

Department Curriculum Authority:	Xiche Hu	Date	2013/04/08
Department Chairperson:	Ronald E. Viola	Date	2013/04/26
College Curriculum Authority or Chair:	Anthony Quinn	Date	2013/10/22
College Dean:	Brian P. Ashburner	Date	2013/10/24
Graduate Council:		Date	1-21-2014
Dean of Graduate Studies:		Date	1-21-2014
Office of the Provost :		Date	

Administrative Use Only

Effective Date:	(YYYY/MM/DD)
CIP Code:	
Subsidy Taxonomy:	
Program Code:	
Instructional Level:	

GREEN CHEMISTRY
CHEM 6200/8200

Instructor: Dr. Mark Mason
3260 Wolfe Hall, 530-1532
Mark.Mason@utoledo.edu

Offering: Fall semester

Lecture: Three 50 minute lectures per week

Credit Hours: 3

Prerequisites: Organic Chemistry II (CHEM 2420)

Description: Green chemistry is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products, including fuels, plastics, polymers, synthetic fibers, pharmaceuticals, food additives, fragrances, pesticides, herbicides, detergents and cleaning supplies. This course will introduce the principles and fundamental concepts of green chemistry, and provide examples of commercial applications of green chemistry. Specific topics are listed below in approximate order of coverage:

Overview, Importance, and Impact of Chemical Industry
Principles and Concepts of Green Chemistry
- Atom economy, green engineering, difference between environmental science and green chemistry

Basic Toxicology
- Risk, hazard, exposure, LD_{50}, LC_{50}, mutagenicity, carcinogenicity, Ames test, endocrine disruptors, ecotoxicity, QSARs

Waste: Production, Problems, Prevention
- Waste minimization techniques, on-site waste treatment, design for degradation, reuse and recycle

Measuring and Controlling Environmental Performance
- Life cycle analysis, cradle-to-cradle, multivariate approaches, green process metrics (E-factor, PMI), environmental management systems, legislation, assessment tools (GreenScreen, EPI Suite, CleanGredients)

Catalysis and Green Chemistry
Organic Solvents: Environmentally Benign Solutions
Renewable Resources
Emerging Green Technologies and Alternate Energy Solutions
- Design for energy efficiency, photochemical reactions, use of microwaves, sonochemistry, electrochemical synthesis

Designing Green Processes
- Reactors, inherently safer design, process intensification, process safety, in-process monitoring

Industrial Case Studies
An Integrated Approach to Greener Chemical Industry
- Includes discussion of supply-chain issues, triple-bottom line

Textbooks: Course material will be taken from the text by Lancaster, supplemented with material from texts by Anastas and Warner, Baird and Cann, and Manahan. Additional examples will be taken from scientific articles and reviews. These have been placed on reserve in Carlson Library and are available for two hours per checkout as well as overnight.

Recommended Textbook

Lancaster, M. *Green Chemistry: An Introductory Text*, Second Edition; RSC Publishing; 2010. ISBN: 978-1-84755-873-2

Supplementary Texts

Anastas, P. T.; Warner, J. C. *Green Chemistry: Theory and Practice*, Oxford University Press, Oxford; 1998. ISBN: 0-19-850234-6

Baird, C.; Cann, M. *Environmental Chemistry*, Fifth Edition; W. H. Freeman and Company, New York; 2012. ISBN-13: 978-1-4292-7704-4. (Toxicology, Chapters 13-15)

Manahan, S. E. *Environmental Chemistry*, Eighth Edition; CRC Press, 2005. ISBN: 1-56670-633-5. (Toxicology, Chapters 22-23)

Grading: Grades will be based on three exams (100 points each), ten quizzes (10 points each), an in-depth project (100 points), and a comprehensive final exam (150 points).

Homework: Problem sets will be distributed periodically. These will not be collected or graded. Answer keys will be posted in a binder in WO 3260 and online.

Academic Dishonesty: The University Policy on Academic Dishonesty will be strictly enforced. See: http://www.dl.utoledo.edu/current_students/academic_dishonesty.htm.