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:

7. Delivery Mode:
   a. Activity Type *
   b. Minimum Credit Hours *

   Maximum Credit Hours *

Primary* Secondary Tertiary
Lecture --SelectType-- --SelectType--

Date Added: 11-26-13
Council Approved: 1-31-14
To Provost: 2-7-14

c. Weekly Contact Hours *

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 __________________________

    ☐ 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 (Permission 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.
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:

Administrative Use Only

Effective Date:  (YYYY/MM/DD)

CIP Code:

Subsidy Taxonomy:

Program Code:

Instructional Level:
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<sub>50</sub>, LC<sub>50</sub>, 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


Supplementary Texts


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](http://www.dl.utoledo.edu/current_students/academic_dishonesty.htm).