The University Of Toledo

New Graduate Course Proposal

* denotes required fields

1. College*: College Nat Sci and Mathematics

   Department*: Chemistry

2. Contact Person*: Dean M. Giolando Phone: 530-1511 (xxx - xxxx) Email: dean.giolando@utoledo.edu

3. Alpha/Numeric Code (Subject area - number)*: CHEM - 5230

4. Proposed title*: Chemistry of Sustainable Ma

   Proposed effective term*: 201730 (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: 4 or Variable: to

7. Delivery Mode:

	Primary*	Secondary	Tertiary
a. Activity Type *	Online	--SelectType--	--SelectType--
b. Minimum Credit Hours *	4		
Maximum Credit Hours *	4		
c. Weekly Contact Hours *	4		

8. Terms offered: ☐ Fall ☐ Spring ☑ Summer

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

Year **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, S/U, WP/WF, PR, I)
    - ○ Satisfactory/Unsatisfactory (A-C, less than C)
    - ○ Grade Only (A-F, WP/WF, 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

    admission into a graduate program or the Masters in Education and Science

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

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

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

    Applications of the principles of chemistry to understand the issues related to a sustainable energy future.

13. Attach a syllabus - a syllabus template is available from the University Teaching Center. Click here for the Center's template.

File Type	View File
Syllabus	View

14. Comments/Notes:

15. Rationale:

CHEM 5230 is a course required for the Master in Education and Science program.

Course Approval:

Department Curriculum Authority:	Xiche Hu	Date	2016/12/12
Department Chairperson:	Jon R. Kirchhoff	Date	2016/12/12
College Curriculum Authority or Chair:	John Bellizzi	Date	2017/01/26
College Dean:	Karen Bjorkman	Date	2017/01/27
Graduate Council:	Constance Schall (GC 2.21.2017)	Date	2017/03/06
Dean of Graduate Studies:	Amanda Bryant-Friedrich	Date	2017/03/06
Office of the Provost :	marcia king-blandford	Date	2017/03/07

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Administrative Use Only

Effective Date:	2017/05/01 (YYYY/MM/DD)
CIP Code:	40.0501
Subsidy Taxonomy:	masters
Program Code:	
Instructional Level:	masters

Registrar's Office Use Only

Processed in Banner on:	2017/03/09
Processed in Banner by:	Tasha Woodson
Banner Subject Code:	CHEM
Banner Course Number:	5230
Banner Term Code:	201730
Banner Course Title:	Chemistry of Sustainable Materials

Chemistry of Sustainable Materials

The University of Toledo
Department of Chemistry and Biochemistry
College Natural Science and Mathematics
(CHEM 5230)

Instructor:	Dean M. Giolando	**Class Location**:	on-line
Email:	dean.giolando@utoledo.edu	**Class Day/Time**:	on-line
Office Hours:	MTWRF 10:00 to 11:00 am		
Office Location:	WO 2271		
Office Phone:	419-530-1511	**Credit Hours**:	4
Term:	Summer 2017		

COURSE/CATALOG DESCRIPTION

Application of the principles of chemistry to understand the issues related to obtaining a sustainable energy future.

STUDENT LEARNING OUTCOMES

Learning Outcome	How Student Achievement of this Outcome Measured?
1. *Communicate effectively*	Assignments require a hand written free response by the students. Also participation-oral assignments are graded throughout the semester. Assessed by instructor of record.
2. *Evaluate arguments in a logical fashion*	Questions on problem sets and examinations require interpretation of data. Assessed by instructor of record.
3. *Employ the methods of inquiry*	Material contained in the course material require students to analyze data relevant to other disciplines. Assessed by the instructor of record.
4. *Acquire an understanding of our global society*	Students are given projects and assignments wherein the course content is placed in a broader context of human interactions with the planet. Assessed by the instructor of record.
5. *Engage in our democratic society*	Course content is provided on topics relevant to today's society so they will be better informed citizens. Assessed by the instructor of record.

TEACHING STRATEGIES

An examination on the course content will be given on the first day to assess the knowledge base of the students on entering the course. This will identify topics for which the students are familiar, which may require only passing review in lecture, and those topics for which the student is lacking in knowledge and experience. Course lectures are modified to maximize student learning of new information.

A project-based approach is used wherein face-to-face lectures begin with a lead-in question, followed by thought experiments addressing the question – with student engaged in oral responses – and finishing with incorporation of new information from the textbook and other sources to give insights into the chemical nature of materials.

Students are broken into groups of 4 to 5 who research topics during class time, they then present their findings to the class as a whole.

PREREQUISITES AND COREQUISITES

Application of the principles of chemistry to understand the issues related to obtaining a sustainable energy future.

REQUIRED TEXTS AND ANCILLARY MATERIALS

There are no standard textbooks available for this course. Source material will be taken from a variety of sources and adapted to stay current with the changing needs of the world energy situation. Some relevant sources, though not exhaustive, are listed below.

1. The Energy Information Administration of the US Department of Energy has a vast store of data online at: eia.doe.gov/.
2. The US Geological Survey also conducts periodic analysis of the fossil fuel resources globally. These can be found at: usgs.gov/.
3. The International Atomic Energy Agency keeps data on nuclear energy: www.iaea.org/.
4. The World Energy Council at: www.worldenergy.org/.
5. The National Renewable Energy Laboratory at: www.nrel.gov/.

Books required

1. *Chemistry,* 7h Ed, 2016, McMurry /Fay/Robinson, Prentice Hall; *Mastering Chemistry code*; (ISBN-13; 978-0-321-94317-0; ISBN-10; 0-321-94317-1)

Books suggested

1. Atkins, Peter, Overton, Tina, Rourke, Jonathan, *Inorganic Chemistry* 6th Ed, W.H. Freeman, New York, 2014.

2. Greenwood and Earnshaw, *Chemistry of the Elements*, Reed, 1998.

3. *Organic Chemistry*, 7th Ed.2014, Paula Bruice; Prentice Hall; (ISBN-13; 978-0-321-80322-1; ISBN-10; 0-321-80322-1)

TECHNOLOGY REQUIREMENTS

Laptop or smart phone to access the web during class.

UNIVERSITY POLICIES

Policy Statement on Non-Discrimination on the basis of Disability (ADA). The University is an equal opportunity educational institution. Please read The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.)

Academic Accommodations

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office.)

ACADEMIC POLICIES

Academic Dishonesty: You are urged to refer to the university's policy on Academic Dishonesty in the university catalogue. Violation of this policy can result in a course grade of **F** with additional university sanctions possible.

Students who will not be able to take an exam at the scheduled time due to an irresolvable conflict with a major responsibility must provide some **written** documentation to verify the conflict. This situation may occur for students on official university business. The exam will be given at another arranged time before the scheduled test date.

Students who miss an exam due to illness, car accident or similar **extreme** circumstance should inform their instructor of their difficulties as soon as possible. These difficulties must also be **documented** by a physician's note, an accident report, etc. An email to your instructor and a telephone call within 24 hours is expected. Students must complete an **Absence Report Form** (obtained from the chemistry office, BO 2022). **Documentation** supporting your excuse must be attached to the form. In all other circumstances a missed exam will result in a grade of zero points.

*(Insert specific academic policies the student is expected to comply with; policies **may** include student conduct, academic dishonesty, missed class policy, student grievances, etc.)*

COURSE EXPECTATIONS

(Insert a clear explanation of any and all course expectations you have. For example, parameters on class start times (tardiness); are late assignments accepted and if so under what circumstances, will late assignments be given full credit, is there extra credit, participation and attendance expectations, etc.)

GRADING

1. Closed book/one hour Examinations (100 points each): totals 300 points;

2. Assignments (20 points each): totals 100 points;

homework assignments covering concepts, issues, and ideas related to a lecture topic and to be completed during the term. Students are encouraged to work together, but assignments turned in that are copies of one another will share the grade.

3. Term Project (100 points): capstone project where students assess the impact of chemistry to a specific energy source. Chose an energy topic from the list provided and determine what it takes to bring the energy source to society. The project is presented to the class with the objective of teaching your friends and peers the most important aspects of your topic.

Abstract (circa 100 words):
Presentations (circa 10 minutes):

1. Ores and minerals; delivering pure elemental product;
2. Desalination; delivering pure drinking water;
3. Nitrogen fertilizer from dinitrogen; delivering food;
4. Phosphorous fertilizer from ores; delivering food;
5. Sequestering nutrients from farm run-off;
6. Gasoline from oil; delivering a liquid fuel;
7. Diesel from synthesis gas (CO/H_2) (Fischer-Tropsh);
8. Natural gas as a fuel;
9. Methane reforming;
10. Alcohols as a fuel;
11. Lipids as a fuel;
12. Oil as a fuel;
13. Coal as a fuel;

14. Si based photovoltaics;
15. CdTe based photovoltaics;
16. Solar thermal, large-scale electricity;
17. Solar Thermal, residential-scale hot water;
18. Ocean power;
19. Wind power;
20. Geothermal;
21. Use of microbes/algae/yeasts;
22. Nuclear Power;
23. Hydroelectric;
24. Anaerobic digesters.

4. Final Examination (200 points): comprehensive final examination;

5. Participation during class (50 points).

6. Students will independently research a topic (100 points) in chemistry related to sustainiblity, prepare a one-page abstract, and a ten page paper on the subject. The abstract must include a minimum of 10 key references cited in the text. References must be listed using standard ACS format as found in the *ACS Style Guide* and in the January 2017 issue of *Journal of the American Chemical Society*. The abstract should be single-spaced, with 1" margins, and in Times or Times New Roman size 12 font. In the paper, students must define the topic, provide pertinent background and examples and explain the relevance to society. Details to present may include synthetic schemes, bonding descriptions, mechanistic details, and commercial significance. The presenter must be prepared to answer questions from the instructor of the course.

Topics could include, but are not limited to, the following:

Water shift reaction	Hydrogenases
Fischer Tropsh	Nitrogenase
C–H Bond Activation	Methane reforming
Chemical Vapor Deposition	Shell Higher Olefins Process
Hydroformylation	Zeolites
Nanotechnology	Renewable Energy

Final Grading

A, 100-90; B, 89-80; C, 79-70; D, 69-60; F, <59%).

COURSE SCHEDULE

Week 1

1. Where does it all come from? (Chemistry of the Elements)
   - Origin of the elements
   - Abundance of the elements in the universe and Earth's crust
   - Binding of electron to the nucleus
   - Building the Periodic Table
   - Formation of covalent bonds

Week 2

2. Chemistry Behind Recycling and Reuse
    - Common minerals
    - Production of silicon and aluminum metals
        - Aluminum recycling
    - Metal recycling (McGraw-Hill: Handbook of Recycling)
    - Plastics recycling

3. Carbon, Hydrogen and Oxygen Bonds
    - Water, carbon and nitrogen cycles
        - Desalination of sea water
    - Organic chemistry found on the Earth's crust
    - Natural polymers in nature

Week 3

4. Advantage and Disadvantages of Biomass and Fossil Fuels
    - Bio –molecules, organic compounds in living systems
        - Precursors to fossil fuels
    - Breaking down the organic material to bio-fuels
    - Use of algae systems

5. Fuels of Today and into the Future
    - Gasoline from oil
    - Diesel from Syn gas (CO/H_2): Fischer Tropsh process
        - Preparation of CO from carbon sources
    - Methane, propane and butane; Ethanol and butanol
    - Energy content of carbon based fuels: sticks to coal

Week 4

6. Nature's Sources of Energy
    - Photosynthesis
    - Hydrogenases
    - Methane from microbes
        - On the farm and in the landfill
7. Hydrogen as a fuel
    - Production of H_2; from coal, methane or water
    - Uses of hydrogen in fuel cells
        - Overview of the different types of fuel cells

Week 5

8. Solar Photovoltaics
    - How solar cells generate electricity
    - Si; Crystalline and amorphous
    - CdTe
    - $CuInSe_2$

Week 6

9. Solar Photovoltaics

TiO_2 based
Earth Abundant
Nano technology
Organic

Week 7

10. Solar Thermal
    - How to make use of the thermal heating
    - Materials needed for
        - Hot water heaters
            - The Hawaiian Electric Power Utility model
        - Generation of electricity
11. Nuclear
    - Sources of fuel, Refinement of ores
    - Reclamation of spent fuels
    - Advantages/Disadvantages

Week 8

Term project Presentations