The University Of Toledo

New Graduate Course Proposal

* denotes required fields

1. College*: College Nat Sci and Mathematics

   Department*: Chemistry

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

3. Alpha/Numeric Code (Subject area - number)*: CHEM - 5170

4. Proposed title*: Chemistry Instrumentation Te

   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: 2 or Variable: to

7. Delivery Mode:

	Primary*	Secondary	Tertiary
a. Activity Type *	Regular Lab	--SelectType--	--SelectType--
b. Minimum Credit Hours *	2		
Maximum Credit Hours *	2		
c. Weekly Contact Hours *	8		

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

    CHEM 5160

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

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

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

    The study of advanced instrumentation techniques and structural determination of organic and inorganic compounds with an emphasis on pedagogical aspects of the techniques. Approved chemical safety goggles meeting the American National Standard Z87.1-1968 must be worn by every student during every laboratory class meeting.

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 5170 is a new graduate level course required of the approved Masters of Education and Science (MES) program.

Course Approval:

Department Curriculum Authority:	Xiche Hu	Date	2016/12/12
Department Chairperson:	Jon 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

print

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:	5170
Banner Term Code:	201730
Banner Course Title:	Chemistry Instrumentation Techniques

Chemistry Instrumentation Techniques

The University of Toledo
College of Natural Sciences and Mathematics
Department of Chemistry and Biochemistry
CHEM 5170

Instructor:	Dr. Kristi Mock	**Term**:	Summer III 2017
Email:	kristi.mock@utoledo.edu	**Class Day/Time:**	6/12-8/4
Office Hours:	by appointment	**Lab Location**:	BO 3087
Office Location:	BO 2086-G	**Lab Day/Time**:	6/26-6/30; 9am-1pm and 2pm-6pm
Office Phone:	419-530-4080	**Credit Hours:**	2

COURSE/CATALOG DESCRIPTION

The study of advanced instrumentation techniques and structural determination of organic and inorganic compounds with an emphasis on pedagogical aspects of the techniques. Approved chemical safety goggles meeting the American National Standard Z87.1-1968 must be worn by every student during every laboratory class meeting.

COURSE OVERVIEW

The purpose of this laboratory is to introduce students to the instrumentation that chemists use to analyze and characterize molecules. After learning about and understanding those techniques, students will apply their knowledge to analyze and determine the composition of (un)known compounds. The online component of this course will take place over an 8 week period. You will prepare laboratory prelab write-ups based on provided laboratories. The experiments will be performed during a 1 week intensive laboratory experience on campus at the University of Toledo. In the following weeks you will write lab reports for each lab as well as a learning study plan for students of varying levels of education. You will also participate in online discussion boards as well as two online quizzes.

STUDENT LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Demonstrate their ability to make observations and analyze scientific data.
2. Demonstrate their knowledge of chemical laboratory safety rules through their laboratory practice, including the ability to dispose of waste properly.
3. Demonstrate an ability to use typical scientific measurement devices and know their appropriate level of accuracy.
4. Identify and assess the purity of organic compounds using analytical techniques; including IR and NMR.
5. Understand the fundamental concepts behind the various advanced instrumentation techniques and use these techniques to record molecular data.
    a. Nuclear magnetic resonance spectroscopy (NMR)
        i. 1-dimensional ^{1}H-NMR analysis
        ii. 1-dimensional ^{13}C-NMR analysis
    b. Scanning electron microscopy (SEM)
    c. Single crystal diffractometry
    d. Matrix-assisted laser desorption/ionization (MALDI)
    e. Time of flight (TOF) mass spectroscopy
    f. Elemental analysis (CHN analysis)
    g. Powder X-ray diffraction

h. Ultraviolet-visible spectrophotometry (UV-Vis)
i. Infrared spectroscopy (IR)
j. Gas chromatography (GC)
k. Mass spectrometry (MS)
l. High performance liquid chromatography (HPLC)

6. Deduce organic structures using spectroscopic methods.
    a. Determine structures from molecular formulas, molecular mass, and other sources of information.
    b. Deduce unknown structures and fully assign an NMR spectrum to the structure.
    c. Assign key peaks in an IR spectrum.
    d. Deduce unknown structures and fully assign an IR spectrum to the structure.
7. Separate mixtures using GC and HPLC methods.
8. Be able to follow a detailed experimental procedure and construct a flow diagram to illustrate it.
9. Demonstrate the ability to maintain a proper laboratory notebook
10. Construct a lab report that includes an analysis of the data collected, and discussion of the outcomes and answers to open questions associated with the experiment.
11. Create a lesson plan for one of the laboratory experiments done in the laboratory.
12. Evaluate student problems and develop methods to assist them.

TEACHING STRATEGIES

This course is, in part, an online course that will include quizzes, laboratory reports, group discussion boards and developing a learning study plan. The other part of this course will be face to face, designed to stimulate student learning through performance of experiments.

PREREQUISITES AND COREQUISITES

Students must have graduate status and have completed CHEM 5160 with a passing grade.

REQUIRED TEXTS AND ANCILLARY MATERIALS

The following materials are required for this course:

- *Chemistry Experiments For Instrumental Methods* Sawyer, D.T.; Heineman, W.R.; Beebe, J.M. 1984.
- Additional laboratory experiments from the literature can be found in the Journal of Chemical Education and at the Greener Education Materials for Chemists website (http://greenchem.uoregon.edu/Pages/AboutGEMs.php#Incorporate)
- A laboratory notebook with carbon(less) pages.
- Approved safety goggles (can be purchased in class the first day of lab for $10, cash only)

RECOMMENDED TEXTS AND ANCILLARY MATERIALS

- *Principles of Instrumental Analysis* Skoog, D.A.; Holler, F.J.; Nieman, T.A. 6th ed., 2007.

The TECHNOLOGY REQUIREMENTS

Blackboard (https://blackboard.utdl.edu/webapps/login/) will be used on a regular basis in this course. Students need to have access to a properly functioning computer throughout the semester. Updated software is available from the Online Learning Download Center (https://www.utoledo.edu/dl/main/downloads.html). Use of Microsoft Word and PowerPoint (or the equivalent) will be required to present some course material.

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

Laboratory Attendance Policy: Attendance is **MANDATORY**. Due to the compact nature of this laboratory course no make-up laboratory experiments will be permitted. You are required to be on time and properly prepared for the laboratory of that session, if you are not prepared you will not be permitted into the laboratory and will receive a 0 for that laboratory experiment.

Safety Requirements: There will be another document (provided by the Chemistry Stockroom) that will go over specific safety policies and procedures, but here are the basic rules of the lab:

1. Eating, drinking, and smoking are NOT PERMITTED in the laboratory.
2. Non-registered persons are not permitted in the laboratory.
3. Appropriate laboratory apparel including footwear is required (i.e.: jeans, cotton shirts, no loose clothing, etc.). If students are wearing inappropriate clothing, they will be asked to leave class in order to change their clothes.
4. Safety goggles MUST BE WORN BY EVERYONE while experiments are being conducted. Your instructor will determine and announce when goggles may be removed. The appropriate eyewear must be splash goggles, which are available for purchase from the UT bookstore.

Students should consult the handout from the UT Chemistry Stockroom concerning additional rules and guidelines for laboratory work. ANY violation of the safety rules/guidelines will result in a loss of points. If a student repeatedly violates these safety rules, the laboratory instructor has the right to remove the student from the laboratory room.

Academic Dishonesty: The academic honesty policies, as stated in the 2016-2017 UT Catalogue will be STRICTLY ENFORCED. Any student found violating the UT academic honesty policies – including (but not limited to) copying from someone else's laboratory notebook, falsifying documents, plagiarism, will be penalized in accordance with these policies.

Special Needs: The University is an equal opportunity educational institution. If you have special needs with respect to your participation in this course, please make an appointment to discuss this matter with the laboratory coordinator. The lab coordinator will work with you and the Student Disability Services to make appropriate accommodations for your needs.

Subject to Change: Any changes to the Syllabus will be announced in class, through Blackboard or your Rockets email.

COMMUNICATION GUIDELINES As your instructor, I am here to help, and will do my best to respond to email within 24 to 48 hours. Please do not anticipate a response over weekends or holidays.

Students are expected to check their UT email account and blackboard frequently for important course information.

COURSE EXPECTATIONS

1. Read the laboratory assignment and appropriate lecture material prior to each laboratory session. It is required that a laboratory notebook be kept to record observations and experimental results.
2. Be on time and use the full laboratory period.
3. Ask questions and participate in each activity.
4. Turn in all work as assigned.
5. Clean up: Be certain that your area of the laboratory table is properly cleaned after use. Wash and return all glassware and other instruments to the proper areas. Check the sink to be sure that it is clear of all glassware and trash.

GRADING It is a very high priority to your instructor to ensure fairness and equity in all grading aspects of the course. There is nothing about this class that requires a certain number of students to get a certain grade. **We don't use a curve**, so every one of you can achieve the grade that you are willing to earn!

Course Points The following is the distribution of possible points in the course:

Quizzes: 2 @ 50 points each	100 pts
Worksheets: 10 @20 points each	200 pts
Discussion Board Participation	100 pts
Notebook Laboratory Reports: 6 @ 100 pts each	600 pts
Formal Laboratory Report: 1@ 200 pts each	200 pts
Learning Study Plan	100 pts
Total:	**1300 pts**.

The grading scale for this class is:

A = 100 – 93%	A- = 92 - 90%	B+ = 89 -87%
B = 86 – 83%	B- = 82 - 80%	C+ = 79 - 77%
C = 76 - 73%	C- = 72 - 70%	D+ = 69 - 67%
D = 66 - 63%	D- = 62 - 60%	F = 59 - 0%

Drop, Withdrawal and Incomplete Grades Course drop and withdrawal procedures have been set by the University. **Dropped** ***courses do not appear on your transcript. The deadline for dropping is ~~9/5~~. You may*** **withdraw** ***from the course and receive a grade of W. The deadline for withdrawal is ~~10/28~~. W's do not affect your GPA***.

A course grade of **Incomplete** is given only to those who have completed all but a small percentage of course requirements for an acceptable reason.

COURSE SCHEDULE

Week 1 and 2: Introduction, pre-lab discussion boards, worksheets including practice spectra

Week 3: (in lab on UT's campus) (sample schedule as students will need to rotate the labs due to instrument availability)

Day 1 am: NMR training and ICenter introduction

Day 1 pm: Synthesis of biodiesel from various vegetable oils

Day 2 am: Hydrolysis of Polyethylene Terephthalate (PET)

Day 2 pm: Characterization of PET (IR, ^{1}H NMR, and ^{13}C NMR of starting and ending products)

Day 3 am: HPLC of caffeine

Day 3 pm: Quantitative analysis of copper in fertilizer (AA)

Day 4 am: Characterization of the biodiesel synthesized from vegetable oil (GC-MS)

Day 4 pm: Characterization of 4-Methylumbelliferone (UV, Fl, IR, ^{1}H-NMR, and ^{13}C-NMR)

Day 5 am: Analysis of Unknown Compound (UV, IR, ^{1}H-NMR, and ^{13}C-NMR)

Day 5 pm: Analysis of Unknown Compound

Week 4 - 7: Weekly post-lab discussion boards, laboratory reports due

Week 4: PET report due

Week 5: HPLC and biodiesel reports due

Week 6: Characterization of 4-Methylumbelliferone and AA reports due

Week 7: Unknown report due

Week 8: Laboratory lesson plan for one laboratory done in class and proposal for how it can be adapted for high school students due.