Course Outline of Record

Los Medanos College 2700 East Leland Road Pittsburg CA 94565 (925) 439-2181

Course Title: Organic Chemistry Subject Area/Course Number: CHEM-029

New Course ☐ OR **Existing Course** ☒

Instructor(s)/Author(s): Dennis Gravert

Subject Area/Course No.: CHEM-029 **Units: 5**
Course Name/Title: Organic Chemistry
Discipline(s): Chemistry

Pre-Requisite(s): CHEM-028 or the equivalent
Co-Requisite(s) : none

Advisories : none

Catalog Descriptio :

Chemistry 29 is a study of the physical and chemical properties of organic compounds. The principles and practice of common synthetic and analytical procedures will be introduced. This is the second semester of a two-semester Organic Chemistry sequence. CHEM-029 explores the chemistry of aromatics, alcohols, ethers, aldehydes, ketones, carboxylic acids & derivatives, carbonyl substitution & condensation reactions, and selected biomolecules. The techniques of instrumental analysis that were introduced in CHEM-028 will be further explored in the context of these new organic families.

Schedule Description :

Chemistry 29 is the second semester of a one-year course in Organic Chemistry. The principles and practice of common synthetic and analytical procedures will be introduced. It is a requirement for pre-dental, pre-pharmacy, and pre-medical students, along with those majoring in chemistry, and some types of engineering and biological sciences.

Hrs/Mode of Instruction: Lecture: __54_ Scheduled Lab: _108 HBA Lab: ____ Composition: ____ Activity: ____ Total Hours 162
(Total for course)

Credit ☒ Credit Degree Applicable (DA)
☐ Credit Non-Degree (NDA)
(If Non-Credit desired, contact Dean.)

Grading ☐ Pass/No Pass (P/NP)
☒ Letter (LR)
☐ Student Choice (SC)

Repeatability ☒ 0
☐ 1
☐ 2
☐ 3

Last date of Assessment: ___Spr 2012____ Cohort #: __1__

Please apply for: LMC General Education Requirement(s): None
(Please list the proposed area(s) this course meets, or indicate "none")

Transfer to: ☒CSU ☒UC ☒ IGETC Area 5A/5C ☒ CSU GE Area B1/B3 ☒ C-ID Number Chem 160S

Course is Baccalaureate Level: ☒ Yes ☐ No

Course Outline of Record

Los Medanos College 2700 East Leland Road Pittsburg CA 94565 (925) 439-2181

Course Title: Organic Chemistry Subject Area/Course Number: CHEM-029

Signatures:

Department Chair _____ Date _____

Librarian _____ Date _____

Dean _____ Date _____

Curriculum Committee Chair _____ Date _____

President/Designee _____ Date _____

CCCCD Approval Date (Board or Chancellor's Office) _____ Date _____

For Curriculum Committee Use only:

STAND ALONE COURSE: YES NO

FOR OFFICE OF INSTRUCTION ONLY. DO NOT WRITE IN THE SECTION BELOW.

Begin in Semester _____
Dept. Code/Name:_____
ESL Class: ____Yes / No_____
Class Code
- ☐ A Liberal Arts & Sciences
- ☐ B Developmental Preparatory
- ☐ C Adult/Secondary Basic Education
- ☐ D Personal Development/Survival
- ☐ E For Substantially Handicapped
- ☐ F Parenting/Family Support
- ☐ G Community/Civic Development
- ☐ H General and Cultural
- ☐ I Career/Technical Education
- ☐ J Workforce Preparation Enhanced
- ☐ K Other non-credit enhanced
- ☐ Not eligible for enhanced

Catalog year 20____/20_____
T.O.P.s Code: _____
DSPS Class: ____Yes / No_____
SAM Code
- ☐ A Apprenticeship
- ☐ B Advanced Occupational
- ☐ C Clearly Occupational
- ☐ D Possibly Occupational
- ☐ E* Non-Occupational
- ☐ F Transfer, Non-Occupational

*Additional criteria needed
- ☐ 1 One level below transfer
- ☐ 2 Two levels below transfer
- ☐ 3 Three levels below transfer

Class Max: _____
Crossover course 1/ 2: _____
Coop Work Exp: ___Yes / No_____
Remediation Level
- ☐ B Basic Skills
- ☐ NBS Not Basic Skills

Course approved by Curriculum Committee as Baccalaureate Level: _Yes / No_

LMC GE or Competency Requirement Approved by the Curriculum Committee: _____

Distribution: Original: Office of Instruction
Copies: Admissions Office, Department Chairperson

Institutional Student Learning Outcomes

Check the institutional student learning outcomes (or category of outcomes) below that are reflected in your course:

☐ **General Education SLOs (Recommended by GE Committee)**
At the completion of the LMC general education program, a student will:
1. read critically and communicate effectively as a writer and speaker.
2. understand connections among disciplines and apply interdisciplinary approaches to problem solving.
3. think critically and creatively
4. consider the ethical implications inherent in knowledge, decision-making and action.
5. possess a worldview informed by diverse social, multicultural and global perspectives.

(Each of the above student learning outcomes for the general education program has a written explanation with illustrations and examples of its application within courses, as well as specific assessment criteria. Consult the GE program information pages.)

☒ None

Program-Level Student Learning Outcomes (PSLOs) - Chemistry

At the completion of the program, the student will have done the following:

1. Applied scientific methodology, in all its explicit steps, to either:
   - solve a complex problem posed in the classroom, or
   - complete a significant laboratory analysis, or
   - carry out an extensive study at one of LMC's field stations.

2. Solved problems concerning the atomic and molecular structure of matter, using the periodic table plus quantum mechanics as the organizing and predictive models for this analysis.

3. Solved stoichiometric problems, including those complicated by the presence of limiting reagents.

4. Correctly predicted the products of standard inorganic, organic, biochemical, or nuclear reactions.

5. Applied the principles of thermodynamics and kinetics to solve problems:
   - involving energy and entropy changes characteristic of chemical and physical reactions
   - concerning rates and mechanisms of chemical reactions
   - involving the principles of equilibrium

6. Demonstrated an understanding of electromagnetic radiation (i.e., light energy) and its interactions with matter, by carrying out spectroscopic analyses of atoms and compounds.

7. Conducted laboratory or field analyses using modern, professional technologies, selected from colorimetric, titrimetric, gravimetric, electrochemical, spectrometric, and chromatrographic equipment and instruments.

8. Engaged in at least one hands-on research or restoration activity at a field site of LMC or a community partner, in order to utilize the distinct opportunity provided by having the California Delta in our backyard, and to appreciate the effort needed to act as good stewards of our local watersheds.

Course-Level Student Learning Outcomes (CSLOs):

At the completion of Chemistry 29, the student will be able to:

CSLO 1: Predict the products of chemical reactions involving aromatics, alcohols, ethers, aldehydes, ketones, carboxylic acids & derivatives, carbonyl substitution & condensation reactions, and use this skill set to successfully outline synthetic organic sequences. (PSLO 2, 3, 4, 5)

CSLO 2: Apply the principles of thermodynamics and quantum mechanics to describe and explain the special stability and unique chemistry of aromatic compounds. (PSLO 1, 2, 4, 5, 6, 7)

CSLO 3: Perform laboratory analyses of compounds using modern qualitative and quantitative methods, including the use of chromatographic and spectrometric instruments. (PSLO 1, 6, 7, 8)

Assessments:

	Homework	Unit Exams	Final Exam	Laboratory
CSLO 1	X	X	X	X
CSLO 2	X	X	X	X
CSLO 3				X

CSLO 1:
Homework: These assignments contain problems found at the end of each chapter of the textbook. Each problem provides students with the opportunity to apply a chemical concept learned in lecture or lab, as well as the opportunity to develop problem-solving strategies and techniques. Students answer questions such as, "What is the product of a reaction involving methoxybenzene and anhydrous HBr?"

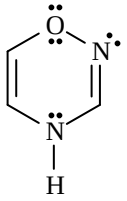
Unit Exams and Final Exam: Students work independently on problems involving all chemical concepts covered in a specific unit, or in the entire course. Students answer questions such as, "Outline the complete synthesis of hexyl 2-chloro-4-fluorobenzoate using the reactions studied in this course." Exams require students to think critically and apply knowledge and skills learned in class and in the laboratory.

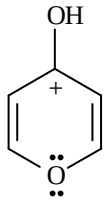
Laboratory: Before, during, and after carrying out laboratory projects, students complete lab reports. These lab reports include the students' answers to such questions as, "Use the results of your polarimeter analysis to calculate the mass percentages of (-)-menthone and (+)-isomenthone in the product mixture, and account for this equilibrium composition using conformational analysis." Laboratory activities enable students to experience chemistry in action. They must apply concepts presented in the lecture and develop the mechanical skills needed to succeed in science laboratories in academia and the workplace. Lab reports provide opportunities for students to process and reflect on their laboratory experience and demonstrate in writing their understanding of the lab projects.

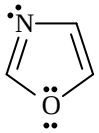
CSLO 2:
Homework: These assignments contain problems found at the end of each chapter of the textbook. Each problem provides students with the opportunity to apply a chemical concept learned in lecture or lab (such as how to apply the Huckel theory to predict the aromaticity, non-aromaticity, or anti-aromaticity in a series of compounds) as well as the opportunity to develop problem-solving strategies and techniques.

Unit Exams and Final Exam: These assessments enable students to demonstrate their understanding of aromaticity in the contexts of thermodynamics, quantum mechanics, and physical and chemical behavior of aromatic compounds. Students answer questions such as the following:

For each molecule below, predict whether the molecule would be expected to show aromatic character or not. Explain your answer in each case.



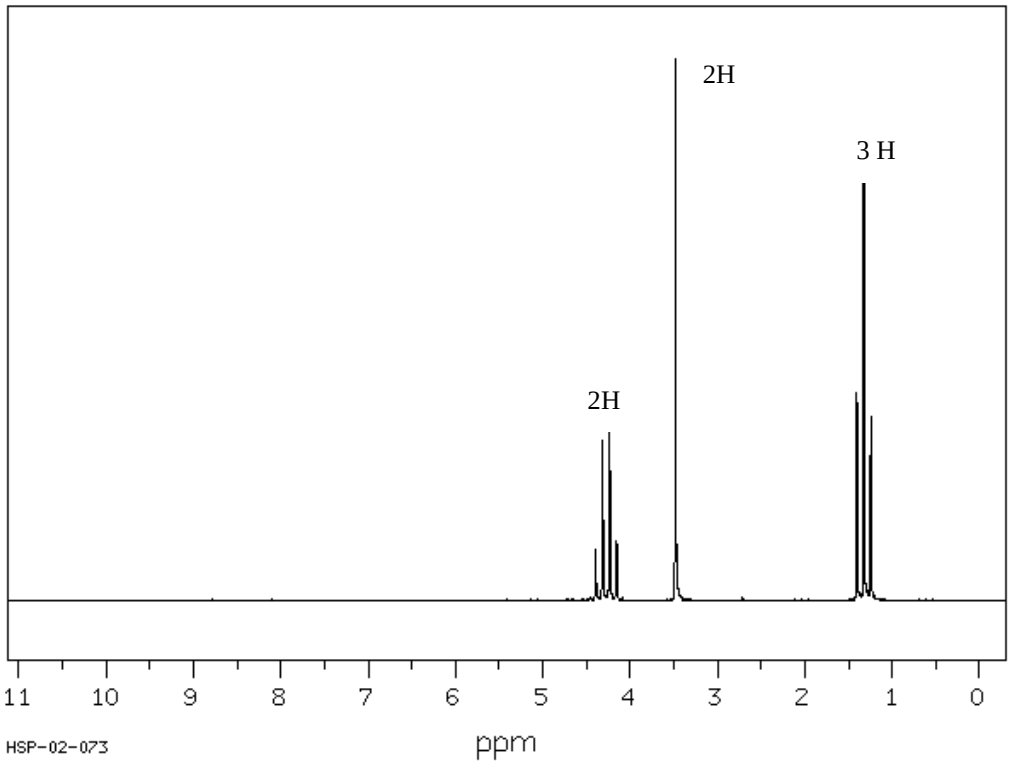




Laboratory: Before, during, and after carrying out laboratory projects, students complete lab reports. By writing lab reports, students demonstrate their understanding of the chemical concepts encountered during lab. These lab reports include the students' answers to such questions as the following:

To answer the following questions, consider the data and ^{1}H NMR spectrum below:

The mass spectrum of this compound shows a molecular ion at *m/z* = 113, the IR spectrum has characteristic absorptions at 2270 and 1735 cm^{-1}, and the ^{13}C NMR spectrum has five signals.



a) Based on the mass spectral data and the IR data, what functional groups are present in this compound?
b) How many types of nonequivalent protons are there in this molecule?
c) Describe the signal at 3.5 δ in terms of its integration, splitting pattern and chemical shift.
d) Describe the signals at 4.35 δ and 1.3 δ in terms of their integration, splitting and chemical shift.
e) What is the significance of the ^{13}C NMR data?
f) Propose a structure for this compound.

CSLO 3:

Laboratory: Students analyze products of chemical reactions using chromatographic and spectroscopic instruments such as GC, HPLC, IR, NMR, MS, and UV-VIS. When analysis is complete, students document their work by writing a formal lab report. A typical assignment would be: "Explain in detail how the IR spectra of benzaldehyde, benzoin, benzil, and benzylic acid chart the functional group changes that occurred during your synthesis of benzylic acid." Students learn proper laboratory techniques as well as develop their investigative skills.

By writing lab reports, students demonstrate their analytical skills and ability to draw conclusions to answer the investigative problems presented in lab.

Method of Evaluation/Grading:

A-level student work

For CSLO 1, A-level student work demonstrates a highly trained level of problem solving ability. The work provides evidence that the student can apply appropriate course concepts, thoroughly understands the principles of organic reactions, and can carry out the logical steps to obtain a solution to a multi-step organic synthesis problem.

For CSLO 2, A-level student work demonstrates a thorough understanding of the principles of aromaticity. The work provides evidence that the student knows the corresponding structural, thermodynamic, and quantum mechanical concepts, and that the student can skillfully apply this knowledge to solve problems with a minimum of errors.

For CSLO 3, A-level student work in the laboratory provides evidence that the student can safely and accurately plan, conduct, and analyze experimental work on a chemical problem. This includes designing and describing the necessary experimental method to obtain data; collecting, organizing, and analyzing the laboratory data of sufficient number and relevance; and clearly communicating the results and correct conclusions of the experimental work. Overall, the work displays excellent scientific reasoning and laboratory skills.

C-level student work

For CSLO 1, C-level student work demonstrates a competent level of problem solving ability. The work contains elements as outlined in A-level student work but suffers from several errors of logic or application. The work provides evidence that the student understands some reaction concepts and methods of problem solving; however, the complete and correct solution is sometimes missing, and s/he is generally not able to solve problems in organic synthesis.

For CSLO 2, C-level student work demonstrates an adequate understanding of the principles of aromaticity, but some concepts are not understood completely or not applied correctly. A large part of the student work is on track, but it is flawed by missing or incorrect elements that prevent the student from reaching a full and correct solution.

For CSLO 3, C-level student work demonstrates a proficient level of laboratory skills. Laboratory reports contain all required elements (description of experimental method, listing of experimental data, analysis of data, and discussion of results and conclusions); however, the elements contain some degree of technical error, incompleteness, evidence of misunderstanding of safety principles or chemical concepts.

Possible point distribution for each type of assignment:

Unit Exams	50%
Final Exam	15%
Laboratory Assignments	25%
Homework	10%
	100% Total

Approximate CSLO Weighting:

CSLO 1: 60%
CSLO 2: 15%
CSLO 3: 25%

Course Content:

Lecture Content

Unit I:

Benzene & Aromaticity
Chemistry of Aromatics: Electrophilic Aromatic Substitution

Unit II:

Alcohols & Thiols
Ethers, Epoxides, Thiols, and Sulfides
Aldehydes & Ketones; Nucleophilic Addition Reactions

Unit III:

Carboxylic Acids & Nitriles
Carboxylic Acid Derivatives & Nucleophilic Acyl Substitution Reactions

Unit IV:

Carbonyl Alpha-substitution Reactions
Carbonyl Condensation Reactions
Amines & Heterocycles

Unit V:

Carbohydrates
Proteins
Lipids

Suggested Lab Content

Safety, Skills, and Notebook Orientation

TLC Analysis of Drug Components

Column Chromatography & UV-VIS Spectroscopy

Nucleophilic Substitution Reactions

Stereochemistry of Addition of Bromine to *trans* –Cinnamic Acid

Structures & Properties of Stereoisomers

Friedel-Crafts Acylation of Anisole

Spectral Identification of Monoterpenes

Preparation of Bromotriphenylmethane & the Trityl Radical

Exp 30 – Synthesis of Triphenylmethanol & the Trityl Carbocation

Borohydride Reduction of Vanillin to Vanillyl Alcohol

Preparation of the Insect Repellant N,N-Diethyl-*m*-Toluamide

Multistep Synthesis of Benzylic Acid from Benzaldehyde

Chemistry Literature Project

Field Studies in the Kirker Creek Watershed

Instructional Methods:

- ☒ Lecture
- ☒ Lab
- ☐ Activity
- ☒ Problem-based Learning/Case Studies
- ☐ Collaborative Learning/Peer Review
- ☐ Demonstration/Modeling
- ☐ Role-Playing
- ☒ Discussion
- ☒ Computer Assisted Instruction
- ☐ Other (explain) _____

Textbooks:

Lecture text: ***Organic Chemistry***, 8th ed., John McMurry Brooks/Cole, 2012.

Lab texts: ***Operational Organic Chemistry***, 4th ed., John Lehman, Prentice Hall, 2009.
or ***Macroscale and Microscale Organic Experiments***, 6th ed., Ken Williamson, Cengage, 2010.