GROSSMONT COLLEGE

COURSE OUTLINE OF RECORD

Curriculum Committee Approval: 04/26/2022

GCCCD Governing Board Approval: 06/14/2022

CHEMISTRY 232 – ORGANIC CHEMISTRY II

1. Course Number Course Title Semester Units

CHEM 232 Organic Chemistry II 5

Semester Hours

3 hours lecture: 48-54 hours 96-108 outside-of-class hours

6 hours lab: 96-108 hours 240-270 total hours

2. Course Prerequisites

A “C” grade or higher or “Pass” in Chemistry 231 or equivalent.

3. Catalog Description

Second of a two semester sequence. The topics covered will include: structure and reactivity of carboxylic acids and their derivatives, amines and other nitrogen functional groups, aromatic compounds, heterocyclic compounds, polyfunctional compounds, conjugation and aromaticity, and multistep organic synthesis**.**

4. Course Objectives

The student will:

1. Predict products and mechanisms of oxidation-reduction reactions in organic chemistry.
2. Predict the products and mechanisms of organic reactions involving organometallic compounds.
3. Distinguish among the numerous types of conjugated unsaturated systems and their use in organic synthesis.
4. Determine whether an organic compound is aromatic and understand electrophilic aromatic substitution reactions.
5. Predict the mechanisms and products of nucleophilic addition and nucleophilic addition-elimination reactions involving carbonyl substrates.
6. Distinguish among the various mechanisms and reactions involving enols and enolates.
7. Distinguish among the various types of reactions and mechanisms involving amines.
8. Distinguish between nucleophilic substitution reactions involving phenols or aryl halides.
9. Design the synthesis and identify intermediates for an organic compound requiring multiple reaction steps.
10. **Demonstrate proficiency in** basic organic laboratory operations such as melting point determination, boiling point determination, liquid-liquid extraction, gravity and vacuum filtration, and both simple and fractional distillation as well as **separation and purification tec**hniques including TLC, column chromatography, recrystallizations and distillations
11. Demonstrate appropriate laboratory notebook recordkeeping techniques. Included in this is a clear outline of the structures of the reactants, solvents, and catalysts needed to optimize yields in a variety of organic reactions.
12. Characterize compounds using a variety of laboratory instrumentation including but not limited to NMR, FTIR spectroscopy, gas chromatography, UV spectroscopy, and HPLC.
13. Synthesize, isolate, purify and characterize compounds using traditional chemistry procedures and modern instrumentation.
14. Predict the outcome of organic reactions.
15. Identify reagents necessary to carry out organic reactions.

p. Perform organic reactions and separations in the laboratory.

q. Design and carry out multistep organic transformations.

5. Instructional Facilities

* 1. Standard classroom and laboratory.
  2. Computer room with computers loaded with molecular modeling and drawing software.
  3. Smart Cart.

5. Instructional Facilities

a. Wall mounted Periodic Chart.

1. Laboratory classroom including but not limited to:

(1) Drying ovens.

(2) pH meters.

(3) Fume hoods.

(4) Hot plates.

(5) Magnetic stir plates.

(6) Triple beam balances.

(7) Analytical balances.

(8) Melting point apparati.

(9) Bunsen burners and microburners.

(10) IR spectrometer.

(11) UV-vis spectrometer.

(12) GC.

(13) Oil baths and resistance heaters.

(14) NMR

1. Three instruments which tremendously increase the quality of the course are a gas chromatograph, infrared spectrometer and NMR spectrometer
2. Variety of organic chemicals and solvents as well as thin layer chromatography supplies

e. Individual student drawers containing:

(1) Kem-Kit (Kontes Company).

(2) Standard laboratory equipment including but not limited to beakers, Erlenmeyer flasks, graduated cylinders, filter flasks, Buchner funnels, glass funnels, pipets, test tubes, test tube racks, glass sample vials, drying tubes, and assorted scoopulas, stir rods and spatulas.

6. Special Materials Required of Student

1. Laboratory apron or jacket.
2. Scientific calculator with exponential and logarithmic functionality.
3. Approved safety glasses or goggles.
4. Molecular model kit.
5. Approved laboratory notebook

7. Course Content

1. Organometallic chemistry
2. Conjugated unsaturated systems
3. Aromatic compounds and their reactivity
4. Nucleophilic addition to carbonyl groups
5. Carboxylic acids and their derivatives
6. Nucleophilic aromatic substitution
7. Multistep organic transformations
8. Electrophilic aromatic substitution.
9. Reactions of enolate anions and enols.
10. Di, conjugated and polyfunctional carbonyl compounds.
11. Heterocyclic and nitrogen (amine) chemistry.
12. Carbon skeleton rearrangement reactions including Claisen, Beckmann, Hoffmann rearrangement reactions and pericyclic rearrangements.
13. Synthesis, isolation, purification and characterization of carbon compounds in the laboratory.
14. Structure and function relationships will be investigated using modeling techniques which include model kits, Spartan molecular modeling software and chemdraw.
15. Use of a variety of laboratory instrumentation including but not limited to FTIR spectroscopy, gas chromatography, UV spectroscopy, and HPLC to characterize products.
16. Multistep synthetic transformations

8. Method of Instruction

1. Lecture with an emphasis on quantitative and qualitative problem solving.
2. Integration of appropriate web-based and computer audiovisual materials such as animations, PowerPoints, videos, and other multimedia, silent and non-silent polls, group work, exit tickets, etc..
3. Computer assisted instruction.

d. Inquiry based laboratory experience.

9. Methods of Evaluating Student Performance

1. Written exams and final exam which may include fill-in-the-blank, short answer, multiple choice, and essay equations.
2. Laboratory activities that evaluate students’ ability to observe the properties of a wide range of organic compounds, to apply competent observational skills, to demonstrate proper collection and recording of data, to assemble and utilize complex glassware setups for synthesis and purification, and to operate modern laboratory instruments.
3. Written laboratory reports that measure students’ ability to interpret and analyze both qualitative and quantitative data. (for example descriptions and analysis of chemical reactions or analytical determinations).
4. Laboratory techniques to include proper safety procedures, use of laboratory equipment, and complete documentation of data.
5. Essays/presentations on topics such as experimental results, descriptive chemistry or current issues in chemistry.
6. Homework and various assignments are used to teach an emphasize content including, but not limited to reading tests, watching videos, solving problems out of the textbook or computer aided instructional exercises, surveys, peer review, discussions, etc.
7. Capstone multistep organic synthesis project

10. Outside Class Assignments

1. Laboratory reports such as descriptions and analysis of chemical reactions or analytical determinations.
2. Essays/presentations on topics such as experimental results, descriptive chemistry or current issues in chemistry.
3. Homework, both text and computer based.
4. Capstone project involving a proposal for a total synthesis of a natural product. Students will show all synthetic steps from commercially available starting materials, and address reaction conditions and stereochemistry in each step.

11. Representative Texts

1. Representative Text(s):

(1) Wade, L.G. *Organic Chemistry*. 9th ed Upper Saddle River, New Jersey: Pearson, 2016.

(2) Lehman, John W. *Multiscale Operational Organic Chemistry*. 2nd ed. Upper Saddle River, New Jersey: Pearson, 2009.

1. Supplementary texts and workbooks:

None

Addendum: Student Learning Outcomes

Upon completion of this course, our students will be able to do the following:

* 1. Demonstrate a working knowledge of the language of organic chemistry.
  2. Recognize the major functional groups of organic compounds.
  3. Predict the major products of chemical reactions of representative organic functional groups.
  4. Apply a theoretical approach to explain the chemical and physical behavior of organic compounds.
  5. Employ laboratory equipment and techniques to collect, analyze and evaluate experimental data.