CHEM 3135: Organic Chemistry II(With lab)

2023 Summer Session	
Total Class Sessions: 25 **Class Sessions Per Week: 5** **Total Weeks: 5** **Class Session Length (Minutes): 145** **Credit Hours: 4**	**Instructor: Staff** **Classroom: TBA** **Office Hours: TBA** **Language: English**

Course Description:

This course will provide the students with thorough understanding and use of theory and practice of organic chemistry through study of structural principles, reaction mechanisms, synthesis, and complex molecules of biological interest. The course will discuss alcohols, aromatic compounds, aldehydes, ketones, carboxylic acids and their derivatives, carbonyl compounds, amines, carbohydrates, lipids, amino acids, and proteins. Basic goals of course are to develop appreciation and skill in methods of molecular analysis.This course will prepare student for work in advanced topics of organic chemistry, biochemistry, chemical engineering, and health related sciences. Included laboratories.

Prerequisites: **Organic Chemistry I with the grade of "C" or better is required. This course is the continuation of organic chemistry I course (we will cover chapters 11-25, some chapter/sections may be omitted according to the course progress and course need decided by the instructor).**

Laboratory Safety:

During this class we will work with a range of solvents, organic materials, acids, and bases which could be harmful if you were to splash them into your eye or onto your skin. For your own protection, we must require you to wear laboratory goggles.

Laboratory Instructions and Materials:

The laboratory portion will consist of five laboratory experiments; students will participate laboratory experiment and individually write a lab report for each experiment.

The lab report should be submitted as a Word document (as an assignment called Lab 1, Lab 2, Lab 3, Lab 4, and Lab 5). More info about specific labs will be posted by the instructor.

Manual: "**A Microscale Approach to Organic Laboratory Techniques,"** by Donald L. Pavia, Gary M. Lampman, George S. Kritz, and Randall G. Engel, 6th edition (2018), Cengage Learning, Boston, MA

Course Textbook and Other Materials:

"Organic Chemistry" T.W. Graham Solomons, Craig B. Fryhle, and Scott A. Snyder, 12th edition (2016), Wiley Publishing, Hoboken, NJ.

Recommended: Lecture Notes provided by the instructor

The Study Guide and Solutions Manual for Organic Chemistry, Twelfth Edition, authored by Graham Solomons, Craig Fryhle, and Scott Snyder with prior contributions from Robert Johnson (Xavier University) and Jon Antilla (University of South Florida), (Paperback: 978-1-119-07732-9; Binder-Ready: 978-1-119-07733-6); contains explained solutions to all of the problems in the text plus an introductory essay "Solving the Puzzle—or—Structure is Everything" that serves as a bridge from general to organic chemistry; summary tables of reactions by mechanistic type and functional group; a review quiz for each chapter; a set of hands-on molecular model exercises

Course Format and Requirements:

Class time will be used for a combination of lectures, class discussions, as well as required laboratory experiments and assignments related to the course subject.

Attendance:

Attendance at lectures is vital to get a thorough understanding of the material. This course requires verbal participation in-class exercises, activities, and contributions to class discussions. Students must be present and actively involved to receive these points.

Course Assignments:

5 Quizzes

Weekly quizzes will usually consist of short answer questions. No make-up quiz will be given.

Exams (Two Midterms and One Final)

Exams may not be taken early, made-up, or turned in late. Students must comply with all Applicable instructions to receive credit. The exams will include discussion questions and case problems. During the exams, each student must work individually without consulting others.

Lab Experiment Assignments

There will be weekly set of a set of assignments to complete at home and submit weekly. The instructor will select and distribute during each class meeting a selection of problems from each chapter. **The assignments will need to be completed and submitted back to the instructors at**

the end of class no. 6, 11, 16, 21, and 25, (usually on Mondays, except the last one). Remember lab safety is the most important and should always keep in mind.

Course Assessment:

Quizzes	-	10%
Midterm 1	-	20%
Midterm 2	-	20%
Laboratory	-	25%
Final Exam	-	25%

Grading Scale (percentage):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
98-100	93-97	90-92	88-89	83-87	80-82	78-79	73-77	70-72	68-69	63-67	60-62	<60

Academic Integrity:

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.
Students are expected to adhere to the standards of academic honesty and integrity that are described in the Chengdu University of Technology's *Academic Conduct Code.* Any work suspected of violating the standards of the *Academic Conduct Code* will be reported to the Dean's Office. Penalties for violating the *Academic Conduct Code* may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the *Academic Conduct Code*.

Special Needs or Assistance:

Please contact the Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.

Tentative Course Schedule:

Class 1:

Topics: Review of the syllabus, introduction to the scope of the course and the overview of the textbook, requirements, and the nature of laboratory assignments and lab safety.

Class 2:

Brief review of organic chemistry basics (from part 1) and intro to Chapter 11. Alcohols and Ethers.

Topics: We will review some basic organic chemistry principles that will serve as building blocks and fundamentals for advances studies of more complex compounds. We provide the introduction to the structures, properties, and nomenclature of common alcohols and ethers. (Sections 11.1 to 11.3)

Practice Problems:

11.25 and 11.26.

Class 3:

Chapter 11. Alcohols and Ethers, continued.

Topics: Discussion of the synthesis of alcohols from alkenes; how alcohols react; use of alcohols as acids; how to convert alcohols into alkyl halides; different alkyl halides; synthesis of ethers; intermolecular dehydration of alcohols to form an ether, the Williamson ether synthesis; analysis of ethers' reactions; epoxides and their reactions; crown ethers. (Sections 11.4 to 11.17)

Practice Problems:

Any ten (10) from 11.27 to 11.45; any three (3) from 11.46 to 11.52; any three (3) from 11.53 to 11.60

Class 4:

Chapter 12. Alcohols from Carbonyl Compounds

Topics: To understand the structure of carbonyl group; oxidation-reduction reactions; alcohols made by reduction of carbonyl compounds; analysis of reduction of aldehydes and ketones by hydride transfer; explanation of oxidation of alcohols; the Swern oxidation and chromic acid oxidation; what are organometallic compounds; preparation of organolithium and organo-magnesium compounds and their reactions; the mechanism of the Grignard reaction; alcohols from Grignard reagents.

Practice Problems:

Any five (5) from 12.9 to 12.18; 12.19 to 12.22; any five (5) from 12.23 to 12.32; any five (5) from 12.33 to 12.39.

Recommended: Try to review -First Review Problem Set (pgs. RPI 1-5, at the end of the chapter 12.

Class 5:
Quiz no. 1 (Chapters 11-12)

Chapter 13. Conjugated Unsaturated Systems

Topics: We will cover conjugation and resonance structures based on radicals, cations, and anions; the unique physical properties of conjugated systems, especially as observed by UV–Vis spectroscopy; a special transformation, named the Diels–Alder reaction, which can combine conjugated molecules known as 1,3-dienes with certain partners to create six-membered rings containing up to four new chirality centers

Practice Problems:
Any eight (8) from 13.18 to 13.36; any five (5) from 13.37 to 13.47; 13.48 to 13.54.

Class 6:
Chapter 14. Aromatic Compounds

Topics: We will review and analyze the structural principles that underlie the use of the term "aromatic," the initial challenge of determining the correct structure of benzene, learn a rule that helps to predict what kinds of molecules possess the special property of aromaticity, identify special groups of molecules that are also aromatic.

Practice Problems:
14.16 and 14.17, any 6 (six) from 14.18 to 14.29; any 4 (four) from 14.30 to 14.38; 14.39 to 14.43.

Class 7:
Quiz 2(Chapter 13-14)

Chapter 15. Reactions of Aromatic Compounds (sections 15.1 to 15.7)

Topics: Review and analysis of electrophilic aromatic substitution reactions and its' general mechanism; halogenation, nitration, and sulfonation of benzene; learning Friedel-Crafts reactions as well as related alkylation and acylation; analysis of synthetic applications of Friedel-Crafts acylation: the Clemmensen and Wolf-Kishner reductions.

Practice Problems:

Any five (5) from 15.20 to 15.32, any 5 (five) from 15.33 to 15.40

Class 8:
Chapter 15. Reactions of Aromatic Compounds (sections 15.8 to 15.15)

Topics: The analysis of existing substituents directing the position of electrophilic aromatic substitution; activating and deactivating effect: how electron-donating and electron-withdrawing groups affect the rate of EAS reaction; directing effects in disubstituted benzenes; reactions of benzene ring carbon side chains; synthetic strategies; nucleophilic aromatic substitution by addition-elimination, with special look at benzene; reduction of aromatic compounds.

Practice Problems:
15.41 to 15.45; any 3 (three) from 15.46 to 15.52; 15.53 to 15.56; any three (3) from 15.57 to 15.66.

Class 9:
Review for Midterm 1, Summary and Q/A (Covering Chapter 11-15)

Class 10 :
Midterm 1 (Covering Chapter 11-15)

Class 11:
Chapter 16. Aldehydes and Ketones (sections 16.1 to 16.6)

Topics: Discussion of nomenclature of aldehydes and ketones including their physical properties; learning the synthesis of aldehydes and the synthesis of ketones; the effects of nucleophilic addition to the carbon-oxygen double bond – the analysis of mechanistic themes.

Practice Problems:
16.22 to 16.24; any four (4) from 16.25 to 16.31, any 4 (four) from 16.31 to 16.44

Class 12:
Chapter 16. Aldehydes and Ketones (sections 16.7 to 16.15)

Topics: Continuation of additions to aldehydes and ketones: addition of alcohols – hemiacetals and acetals; addition of primary and secondary amines; imine and enamine formations; addition of hydrogen cyanide – cyanohydrins; addition of ylides – the Wittig reaction; oxidation of aldehydes; the Baeyer-Villiger oxidation, analysis of chemical and spectroscopic properties of aldehydes and ketones.

Practice Problems:
Any five (5) from 16.45 to 16.52; 16.53 to 16.55; 16.56 and 16.57.

Class 13:
Chapter 17. Carboxylic Acids and their Derivatives (sections 17.1 to 17.6)

Topics: Overview of nomenclature, physical properties, and preparation of carboxylic acids; analysis of acyl substitution – nucleophilic addition-elimination at the acyl carbon; what are acyl chlorides and carboxylic acid anhydrides; learning the synthesis of acyl chlorides using thionyl chloride.

Practice Problems:
17.17 to 17.20; any three (3) from 17.21 to 17.26

Class 14:
Chapter 17. Carboxylic Acids and their Derivatives (sections 17.7 to 17.12)

Topics: Analysis of the characteristics of esters, amides; (closer look at penicillin); overview of derivatives of carbonic acids; decarboxylation of carboxylic acids; what are polyesters and polyamides, including step-growth polymers.

Practice Problems:
17.27 to 17.30; 17.31 to 17.33; any four (4) from 17.34 to 17.42; any six (6) from 17.43 to 17.55.

Class 15:
Quiz 3(Covering Chapter 16-17)

Chapter 18. Reactions at the α Carbon of Carbonyl Compounds.

Topics: Overview of reactions that derive from the weak acidity of hydrogen atoms on carbon atoms adjacent to α carbonyl group, these hydrogen atoms are called the α hydrogens, and the carbon to which they are attached is called the α carbon; the processes by which enols and enolates can be formed by removal of an α hydrogen; the concept of kinetic and thermodynamic deprotonations to generate different enolates from the same starting material; alkylation, acylation, and other electrophile additions to enols and enolates; a special version of the same chemistry using the nitrogen analog of an enol—that is, an enamine.

Practice Problems:

18.15 to 18.20; any three (3) from 18.21 to 18.26; any three (3) from 18.27 to 18.32; 18.33 and 18.34; any 2 (two) from 18.35 to 18.38.

Class 16:
Chapter 19. Condensation and Conjugate Addition Reactions of Carbonyl Compounds

Topics: We will look at additional chemistry of enolates with carbonyl-containing molecules as electrophiles in both condensation and conjugate addition processes; learn reactions using these concepts that allow for the synthesis of varied rings; review a special version of such reactions involving nitrogen that creates some unique carbonyl-containing amines.

Practice Problems:
Any five (5) from 19.23 to 19.32; any five (5) from 19.33 to 19.40; any two (2) from 19.41 to 19.44; any four (4) from 19.45 to 19.54; any four (4) from 19.55 to 19.63.

Class 17:
Review For Midterm 2(Covering Chapter 16-19)

Class 18:
Midterm 2(Covering Chapter 16-19)

Class 19:
Chapter 20. Amines

Topics: We address the properties, structure, and nomenclature of amines; the ability of amines to function as bases, salts, and resolving agents; the synthesis and reactivity of amines.

Practice Problems:
20.19 and 20.20; any six (6) from 20.21 to 20.33; 20.34 and 20.35; any four (4) from 20.37 to 20.44; any six (6) from 20.45 to 20.56.

Class 20:
Chapter 21. Transition Metal Complexes

Topic: We will consider the properties of transition metals and their complexes with certain ligands, overview examples of transition metal–promoted reactions involving palladium, rhodium, molybdenum, ruthenium, and copper, learn the mechanisms to account for the unique power of these transition metal species.

Practice Problems:
Any six (6) from 21.13 to 21.23; 21.24 to 21.28.

Recommended: Try to review the SECOND Review Problem Set, at the end of the chapter.

Class 21:
Quiz 4(Covering Chapter 20-21)

Chapter 22. Carbohydrates (section 22.1 to 22.9)

Topic: Overview of monosaccharides; processes of mutarotation and glycoside formation; examples of other reactions of monosaccharides; oxidation reactions of monosaccharides; effects of reduction of monosaccharides – alditols; effects of reaction of monosaccharides with phenylhydrazones – osazones; overview of the synthesis and degradation of monosaccharides.

Practice Problems:
22.20; any five (5) from 22.21 to 21.30; any five (5) from 22.31 to 21.38.

Class 22:
Chapter 22. Carbohydrates (sections 22.10 to 22.18)

Topics: Look at carbohydrates beyond monosaccharides; overview of the D family of aldoses; Fischer's proof of the configuration of D-+glucose; disaccharides; polysaccharides; overview of other biologically important and (sweet) sugars, what sugars contain nitrogen; look at the glycolipids and glycoproteins of the cell surface; carbohydrates antibiotics; a little 'lecture' about proper use of carbohydrates from nutrition viewpoint.

Practice Problems:
Any two (2) from 22.39 to 22.43; 22.43 to 22.45.

Class 23:
Chapter 23. Lipids

Topics: We will consider the structures and properties of different lipids, review selected examples of important lipids and their functions, and analyze how lipid-based molecules serve as precursors to several unique carbon frameworks, including steroids, waxes, and other signaling molecules.

Practice Problems:
Any five (5) from 23.14 to 203.20; any three (3) from 23.21 to 23.27.

Class 24:
QUIZ no. 5(chapters 22-23)
Chapter 24. Amino Acids and Proteins

Topics: This chapter sections provide overview of the structures and properties of amino acids that constitute proteins; methods to determine the amino acid sequence of a given protein, as well as synthesize it; the primary, secondary, tertiary, and quaternary structures of proteins, and look at selected examples of enzymes and their function.

Practice Problems:
24.17 to 24.20; 24.22 to 24.24.

Class 25:
Review of material ahead of the final exam.

FINAL EXAM (Cumulative, TBA)