CHEM 636– ADVANCED ORGANIC CHEMISTRY – FALL 2026

1. COURSE SECTION

Section	1
CRN	22200
Class day/time	TR 5:00 – 6:15pm
Location	FB 544

2. INSTRUCTORS' INFORMATION

Instructor	Address	Office	Email	Phone
Dr. Sundeep Rayat	Department of Chemistry Ball State University Muncie, IN	FB 502	srayat@bsu.edu	765-285-8308
Dr. Wei Shi		FB 504	wqshi@bsu.edu	765-285-2194

3. COURSE INFORMATION

3.1 COURSE DESCRIPTION

This course is designed to build upon the organic chemistry content taught at the undergraduate level to develop a comprehensive understanding at a more advanced level of the organization, structure, reactivity, and synthesis of organic compounds.

3.2 PREREQUISITES

CHEM 232

3.3 COURSE OBJECTIVES

This course is designed to develop a comprehensive understanding at an advanced level of the structure, reactivity, and synthesis of important classes or organic compounds. You will be able to:

a. Give proper names for compounds from the important classes of organic molecules.
b. Discuss the bonding in molecules in terms of hybridization, resonance, inductive effects, aromaticity, and stereoelectronic factors.
c. Draw and name stereochemical representations and apply the concepts of stereochemistry to organic reactions and mechanisms.
d. Identify the important classes of reagents and reaction mechanistic types. (e.g., nucleophilic and electrophilic substitution, addition, and elimination; and free radical and electrocyclic reactions).
e. Describe the behavior of important organic reactive intermediates (carbocation, carbanions, radicals).
f. Relate kinetic and thermodynamic principles, and transition state theory to the understanding of reaction mechanisms.
g. Correlate structure and reactivity in important classes of organic reactions.
h. Have an overall knowledge of common and useful organic reactions.
i. Provide synthetic approaches to common organic compounds.

3.4 COURSE CONTENT

- *Nomenclature.* Hydrocarbons and important classes of organic compounds including aromatic and heterocyclic systems.
- *Structure, bonding and reactivity.* Hybridization, resonance, conjugation, aromatic character, stereoisomers and their nomenclature, stereoelectronic and inductive effects, acidity and basicity, transition state theory, kinetic and thermodynamic concepts.

- *Reaction types; organic intermediates and mechanism.* Investigation of important reaction mechanisms through the study of intermediates, rates, and isotype effects, carbocations, anions, radicals; nucleophiles, electrophiles; S_N1, S_N2, E1, E2, nucleophilic and electrophilic addition, free radical reactions, electrocyclic reactions, rearrangements, neighboring group participation.
- *Synthesis.* Functional Group interconversions, the disconnect approach, important carbon-carbon bond forming reactions. Diels-Alder reactions, oxidation-reduction reactions, synthesis of moderately complex organic molecules.

3.5 COURSE SCHEDULE

Week	Dates	Tuesday	Thursday
1	25-Aug & 27-Aug	Rayat starts the first half	
2	01-Sep & 03-Sep		
3	08-Sep & 10-Sep		
4	15-Sep & 17-Sep	***Preliminary Project Topics Due***	**Quiz 1**
5	22-Sep & 24-Sep		
6	29-Sep & 01-Oct	***Final Topic and Reference Pdf Due***	
7	06-Oct & 08-Oct	**Exam 1**	Shi begins the second half
8	13-Oct & 15-Oct	***Fall Break***	
9	20-Oct & 22-Oct		
10	27-Oct & 29-Oct		
11	03-Nov & 05-Nov	***Presentation Outline & Bibliography Due***	**Quiz 2**
12	10-Nov & 12-Nov		
13	17-Nov & 19-Nov		
14	24-Nov & 26-Nov	**Exam 2**	***Thanksgiving Break***
15	01-Dec & 03-Dec	***Presentations***	***Presentations***

4. COURSE MATERIALS

- **Required:** Undergraduate Organic Chemistry Text (Klein, McMurry, Carey, Jones, Wade, etc.)
- **Strongly Recommended:** Organic Chemistry: An Intermediate Text by Robert V. Hoffman (2nd Edition)
- **Recommended:** March's Advanced Organic Chemistry by Michael B. Smith (5th, 6th or 7th Edition)
- **Recommended:** Advanced Organic Chemistry: Parts A and B by Francis Carey and Richard Sundberg
- **Recommended:** Molecular Model Kit

5. COURSE ASSIGNMENTS

5.1 PRACTICE PROBLEMS

There are many problems included at the end of each chapter in the intermediate text. You will not be required to turn in solutions; however, it would be in your best interest to work through all of these problems. Working through the problems will help identify where you need more practice. Office hours would be an excellent time to confirm your understanding of these concepts.

5.2 PROJECT PRESENTATIONS

As part of this course, each student will complete a presentation either on a **reaction methodology, mechanistic investigation** or the **total synthesis of a natural product**. The purpose of this project is to develop students' ability to understand, interpret, and critically evaluate primary research articles in the organic chemistry literature while gaining a deeper understanding of concepts in physical organic chemistry, modern

synthetic strategies and reaction design. A list of suggested articles will be provided by the instructors, and the project will be completed in several stages throughout the semester:

Preliminary Project Topics Selection: By the designated due date, students will review the provided article lists, and select one article from each list as their preliminary topics. This allows students to explore multiple articles before making a final selection.

Final Topic Selection: Students will continue reading their preliminary articles and, by the assigned due date, select one article for their final presentation. At this time, students upload a PDF copy of the selected article.

Presentation Outline and Bibliography: By the specified due date, students will submit a presentation outline along with a list of additional scholarly references that will be incorporated into their presentation. The outline should clearly illustrate the organization and progression of the presentation.

Oral Presentation: Each student will give a **15-minute** oral presentation followed by approximately **5 minutes** for questions and discussion. For articles involving **reaction methodology or mechanistic investigation**, presentations should provide a brief overview of reaction and scope. Particular emphasis should be placed on critically evaluating mechanistic studies, such as control experiments, isotope labeling studies, kinetic studies, radical trapping experiments, competition experiments, kinetic isotope effects, Hammett analysis, spectroscopic studies, or computational investigations, where applicable. For **total synthesis**, presentations should include an introduction to the natural product and its significance, relevant background information, the retrosynthetic analysis and overall synthetic strategy, key reactions and mechanisms, important challenges encountered during the synthesis, and an evaluation of the strengths, limitations, and overall significance of the reported work.

Students are expected to use the primary research article as the foundation of their presentation while incorporating additional scholarly sources to provide background and context. Because presentation time is limited, students should carefully plan and organize their presentations to emphasize the most important aspects of the article rather than attempting to cover every experimental detail. All chemical structures, reaction schemes, and mechanisms included in the presentation must be prepared by the student using appropriate chemical drawing software (e.g., ChemDraw). Figures and reaction schemes should not be copied and pasted directly from the published article or other sources, except where permission is explicitly granted by the instructor. Students should also be prepared to answer questions from the instructor and their classmates following the presentation.

Preliminary Topics List	September 15	5 pts
Final Topic	September 29	5 pts
Presentation Outline & Bibiliography	Friday, November 3	10 pts
Oral Presentation	December 1 and 3	80 pts

5.3 Quizzes and Examinations: There will be two quizzes and two exams as indicated below.

Quiz	Date
Quiz 1 (50 points)	September 17
Exam 1 (150 points)	October 6
Quiz 2 (50 points)	November 5
Exam 2 (150 points)	November 26

6. COURSE ASSESSMENT

Students will be evaluated based on quizzes, examinations, and project presentations. The final grade will be based on a total of **500 points**, distributed as follows: two quizzes worth 100 points; two exams worth 300 points and a final presentation worth 100 points.
The grading will be on a **straight percentage scale.** It is possible and desirable that all students earn high grades. We reserve the option of lowering the "cut lines" if it is appropriate.

		A	≥ 92.0%	A-	≥ 90.0%
B+	≥ 87.0%	B	≥ 82.0%	B-	≥ 80.0%
C+	≥ 77.0%	C	≥ 72.0%	C-	≥ 70.0%
D+	≥ 67.0%	D	≥ 62.0%	D-	≥ 60.0%
		F	< 60%		

7. UNIVERSITY POLICIES AND STANDARDS

7.1 UNIVERSITY STATEMENT

We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse.

7.2 DISABILITY STATEMENT

If you need course adaptations or accommodations because of a disability, please contact the instructor of record as soon as possible. Ball State's Disability Services Office coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

7.3 FREEDOM OF EXPRESSION

In this course, we are committed to fostering a learning environment that values intellectual diversity, encourages free expression, and promotes open inquiry. As members of the Ball State Community, we treat each person in the Ball State community with civility, courtesy, compassion, and dignity and respect and learn from differences in people, ideas, and opinions. Please review Ball State University's Statement on Freedom of Expression, the resources on Ball State's Freedom of Expression webpage, and Ball State's Beneficence Pledge.

In the context of this class, **Freedom of expression** means being able to ask questions, offer ideas, propose new hypotheses or engage in open discussions without judgment. It encourages a healthy learning environment where we grow by experimenting—both in lab and in thought. This freedom fuels innovation and scientific discovery. While chemistry is grounded in fundamental principles, anomalies and unexpected results do occur. Scientists must feel free to explore and publish unconventional ideas if they are supported by **evidence-based research**. Scientific knowledge evolves through debate, experimentation, and replication. Therefore, in chemistry, it is not just about expressing an idea—it is about backing it with data, peer-reviewed studies and logical reasoning. Feel free to search the scientific literature to explore different viewpoints, verify results or expand your own understanding of concepts/techniques covered in this course.

7.4 ATTENDANCE

Regular attendance is mandatory. Notify your instructor in advance if you must miss a class. Accommodations for student absences will be made according to the university polices as listed here. If you are forced to miss a lab session due to a family emergency, serious illness, BSU activity or other unforeseen circumstances, you must inform your instructor in advance *via* email or as soon as possible after the absence begins. You may need to provide documentation (with confidential information redacted when appropriate) if requested. Work with your instructor to make-up the missed assignments. Due dates may be extended in case of excused absences.

8. STUDENT SUPPORT SERVICES

Students can benefit from free tutoring and coaching at the Learning Center, mental health assistance at the Counseling Center, and assistance with basic needs at the Basic Needs Hub.

9. CANVAS AND STUDENT PRIVACY

9.1 CANVAS ACCESSIBILITY

Canvas provides a user experience that is easy, simple, and intuitive. Special attention has been paid to making Canvas screen-readable. The Rich Content Editor encourages users to create accessible content pages (i.e. text formatting is accomplished using styles). Canvas is designed to allow limited customization of colors and schemes to be accessible for all users. The National Federation of the Blind granted Canvas the Gold Level Web Certification in 2010. Find more information by visiting the Canvas Voluntary Product Accessibility Template (VPAT).

9.2 FERPA AND PRIVACY

As a student, your educational records are considered confidential. Under FERPA (Family Educational Rights and Privacy Act), your records are confidential and protected. Under most circumstances, your records will not be released without your written and signed consent. However, some directory information may be released to third parties without your prior consent unless a written request to restrict this is on file. You can learn more about student rights to privacy by reading Ball State's FERPA and Privacy and Protection.

10. COURSE EXPECTATIONS AND POLICIES

10.1 COURSE PARTICIPATION EXPECTATIONS

- Make sure you have an on-time arrival and your complete attention in class.
- Submit all assignments electronically by the stated due date.

10.2 FEEDBACK POLICY

- Your instructor will respond to your email within 24 hours during weekdays (Monday-Friday) and within 48 hours on the weekend (barring unforeseen circumstances).
- Your instructor will typically provide feedback on assignments within 5 school days of submission (barring unforeseen circumstances).
- Contact your instructor directly if you have questions or concerns about your performance course.

10.3 LATE ASSIGNMENT POLICY

All assignments are due by 11:59 pm on the due dates indicated. Assignments submitted after the posted due date will be subject to a 10% deduction from the assignment grade for each calendar day they are late. After 5 calendar days, the assignment will no longer be accepted and will receive a score of 0. Example: An assignment that earns 90/100 points but is submitted 1 calendar day late will receive 81/100 points (a 10% deduction). If the same assignment is submitted 3 calendar days late, it will receive 63/100 points (a 30% deduction). Assignments submitted more than 5 calendar days after the due date will not be accepted. Late assignments are only permitted under extenuating circumstances without penalty as determined by your instructor.

11. SUBJECT TO CHANGE STATEMENT

This syllabus is subject to change in the event of extenuating circumstances.