COURSE DESCRIPTION:

*Macromolecules* is the fourth core chemistry course required by all chemistry major and many pre-health students. CHEM 204 focuses on the chemistry of macromolecules; specifically, how sequence (that is, the order of monomers incorporated into the chain backbone) influences structure and properties. The trajectory of the course evolves from consideration of macromolecules with less sequence specificity to those with more specificity, ultimately to template-encoded biomacromolecules (proteins and nucleic acids).

CHEM 204 will introduce non-covalent interactions, particularly the importance of weak interactions in the structural context of polymer chemistry, in which, due to their size and repetitive nature, these interactions can have a significant influence on structure and function. The influence of stereochemistry will also be introduced, in particular with regard to its effect on chain conformation. With reference to specific examples, differences in polymer properties will be illustrated in terms of these concepts (e.g., the difference in mechanical properties between stereo-random and stereo-specific polymers). These differences will lead into a discussion of polymer synthesis, in which different control mechanisms (thermodynamic and kinetic) will be introduced to understand how specificity is introduced into polymer structure during synthesis. Functional group chemistry and associated reactive intermediates will be developed in the context of polymer synthesis using several examples including olefin polymerization (radical, Ziegler-Natta, and living anionic mechanisms) to illustrate the different levels of control. This content will reinforce concepts developed in other courses, especially CHEM 202 and 203. CHEM 204 will then move toward development of the concept of template-driven polymerizations (i.e., biosynthesis), initially introducing the idea of an activated monomer using step-growth polymerization of nylon as an example. The analogy will be drawn further in terms of the biological use of ATP as bond activation energy to drive otherwise thermodynamically unfavorable processes (such as biopolymer synthesis). The effect of sequence specificity in biopolymer synthesis will be interpreted in terms of the resulting structural and functional specificity. Biopolymer synthesis will be interpreted in terms of energy consumption and contrasted with less specific synthesis of analogous organic polymers.

CLASS MATERIALS (REQUIRED):


THE CHEMISTRY UNBOUND CURRICULUM:

The curriculum is a **student-centered**, unifying approach to teaching chemistry that will **break down barriers between traditional chemistry disciplines** to build lasting thematic frameworks and **give students context to real-world problems and solutions.**
CHEMISTRY 204

PEDAGOGICAL APPROACH OF THE CURRICULUM:

“What is important is learning, not teaching. Teaching effectiveness depends not just on what the teacher does, but rather on what the student does.”

- lecture-based teaching is passive for students, and only leads to 10% retention of the lecture material.
- comprehension jumps to 50-90% when students listen, observe, discuss, and participate in or outside the classroom.
- over 100 reputable institutions, such as MIT, Princeton, Harvard, North Carolina State, and Clemson (and now Emory!) use non-lecture-based teaching methods in their undergraduate science courses.

COURSE OBJECTIVES:

Upon successful completion of this course you will be able to:

- Predict and explain polymer structure and properties based on molecular structure of its building blocks and sequence composition.
- Describe the role of non-covalent interactions in polymer structure and properties.
- Identify polymerization reactions based on their chemistry, kinetics and thermodynamics.
- Explain the similarities and distinct features of synthetic and biological polymers.
- Apply computational tools to visualize and model polymer structure.
- Utilize the primary literature to acquire new scientific information.

COURSE COMPONENTS:

CLASS MEETINGS:

This course utilizes a student-centered pedagogical approach which allows students to learn more deeply, become more active participants in their learning, increases student interaction and peer-to-peer learning, and allows students to get more feedback. Class meetings will emphasize the concepts and skills necessary for you to understand and investigate chemical behavior. It is also important that you become conversant with the language chemists use. Research on learning shows that explaining concepts helps you to better understand and retain the material that just merely listening to an explanation. It is therefore important that you prepare for each class, actively participate in class and ask questions when you do not understand the concepts. To help you understand the course material each class session will involve you working in groups to solve problems and explain your problem-solving strategy.

Attendance
You are expected to attend each class period. Attendance is taken at the beginning of class, and it is your responsibility to ensure that your attendance was correctly recorded before you leave at the end of the class period. You are allowed 3 absences during the semester. Each absence exceeding 3 absences will result in a corresponding point deduction from your final course grade (eg. 4 absences= 1 pt, 5 absences= 2 pts etc). There are no excused absences but the ability to miss 3 days of class allows you to take a mental health day (if needed).

You are responsible for all material covered in the class meeting even if you were absent.
Religious Holidays: Instructors are encouraged, not required, to accommodate students' academic needs related to religious holidays. Please make every effort to negotiate your religious holiday needs within the first two weeks of the semester; waiting longer may compromise your instructor’s ability to extend satisfactory arrangements. If you need guidance negotiating your needs related to a religious holiday, the College Chaplain, Rev. Lyn Pace, npace@emory.edu, Candler Hall 202, is willing and available to help. **Please be aware that Rev. Pace is not tasked with excusing students from classes or writing excuses for students to take to their professors. Emory’s official list of religious holidays may be found at http://www.religiouslife.emory.edu/faith_traditions/holidays.html.

Problem Sets
It is anticipated that you will be assigned one problem set per week throughout the semester. The assignment will usually be housed on Canvas. You will be required to upload pdfs of your work so it is recommended that you use a free app such as CamScanner. Late assignments will not be accepted so ensure that you submit your assignments on time. Your lowest worksheet grade will be dropped.

Non-graded Assignments
You are expected to complete all assignments regardless of whether or not they will be graded. You are expected to work all problems in your textbook that are indicated on Canvas, unless otherwise noted.

In-class Assignments
In-class assignments include quizzes and worksheets. Every four checked worksheets will be grouped and assigned a grade equivalent to one quiz grade. Your lowest grouped worksheet or quiz grade will be dropped. You cannot make up in-class assignments (including worksheets) if you are absent.

Examinations
Three (3) exams are scheduled during the regular class period. No make-up examinations will be given. Excuses including the reason for missing an exam must be presented before the scheduled exam- this may be done by email or sending a note to class. If I accept your excuse, the grade obtained on the final exam will count in place of the missed exam. If your excuse is not accepted you will receive a zero for that exam. You may only be excused from missing 1 exam.

Anticipated Exam Schedule:

<table>
<thead>
<tr>
<th>Exam</th>
<th>Projected Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thursday, Feb. 20</td>
</tr>
<tr>
<td>2</td>
<td>Thursday, March 26</td>
</tr>
<tr>
<td>3</td>
<td>Thursday, April 23</td>
</tr>
</tbody>
</table>

Exam dates are subject to change. The sections to be covered in each exam will be announced in class.

Final Exam – will be given during the final exam period.
- **Section 1** (10:00-11:15) on Monday, May 4 at 9 – 12 noon.
- **Section 2** (1:00-2:15) on Thursday, April 30 at 2 – 5 pm.
- **Section 3** (11:30-12:45) on Wednesday, April 29 at 2 – 5 pm.

The final examination is mandatory and will be comprehensive. Any material discussed during the semester may be included in this exam. Final exams will not be returned.
CHEMISTRY 204

COURSE GRADE:
Your course grade will be computed as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Sets</td>
<td>10%</td>
</tr>
<tr>
<td>In class assignments</td>
<td>5%</td>
</tr>
<tr>
<td>Exams (3)</td>
<td>63%</td>
</tr>
<tr>
<td>Final Exam (Cumulative)*</td>
<td>22%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

* I have a growth mindset, inclusive grading policy. Since you will grow in your knowledge throughout the semester, I believe that growth should be reflected in your course grade. Your final exam grade may therefore be used to replace your lowest exam grade with the following exceptions: 1) If you have a zero on an exam due to missing the exam without a valid excuse no grade may be replaced, including the zero. 2) If you missed an exam with an accepted excuse only the grade for the excused exam may be replaced. This means that your final exam would count for 22% of your grade, if it is lower than your other exam grades; or 43% of your overall course grade if it is higher than one of your other exam grades.

Grading Scale

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

Final course grades will only be available in OPUS. Final exam grades will not be distributed.

Errors in grading:
Exams should be reviewed immediately upon return for grading or addition errors. If there appears to be an error, submit your request for a regrade in writing no later than three days after the exam was returned in class. The Regrade Request form is available in Canvas. Please note that partial credit is awarded at the discretion of the instructor and is not negotiable.

HONOR CODE
It is expected that you will adhere to the Honor Code [http://oxford.emory.edu/catalog/regulations/honor-code.html](http://oxford.emory.edu/catalog/regulations/honor-code.html). It is expected that you will not cheat, contribute to or condone the cheating of others. You are therefore expected to submit your own best effort on all assignments. Pens/pencils and a non-programmable calculator are the only tools you are allowed to bring to and use in exams (no cell phones or smartwatches). Having a cell phone/smart watch during a quiz/exam will be treated as a violation of the Honor Code. Unless otherwise specified, collaboration is not allowed in any assignment to be submitted.

FEEDBACK
Feedback is given in a variety of ways – dependent on the type of assignment. Below is the key for feedback given on quizzes/exams.

- CAL – calculation error
- CON – inadequate understanding of concept
- FORM – incorrect formula or wrong use of formula

Q&A SESSIONS
A very brief question and answer session will be conducted in the class session prior to each exam or at an announced out of class meeting time (as time permits).
CHEMISTRY 204

CANVAS
Canvas will be the primary means of communicating outside of class. It also houses all course content and course resources. Students are also expected to read the Canvas site daily. It is extremely helpful to receive Canvas notifications.

AVAILABLE RESOURCES
- Physical copies of the textbook used in this course (as well as solutions manual) are available as course reserves in the library.
- A few modeling kits are also available in the library reserves.
- Need help? – please come to office hours as soon as you experience difficulty.

ACCOMMODATION
The Office of Accessibility Services (OAS) works with students who have disabilities to provide reasonable accommodations. In order to receive consideration for reasonable accommodations, please contact the OAS and complete the registration process. Faculty may not legally provide you with accommodations until an accommodation letter has been processed and discussed with them; accommodations do not start until this point and are not retroactive. Students registered with OAS who receive a letter outlining specific academic accommodations are thus strongly encouraged to immediately coordinate a meeting with their professors to discuss a protocol to implement accommodations that will (or may) be needed over the course of the semester. This meeting should occur as early in the term as possible. Contact Megan Bohinc in OAS for more information at (770) 784-4690 or oas_oxford@emory.edu.

ADDITIONAL INFORMATION
Exam keys will be posted on Canvas. Exam keys are posted 24 hrs after the exam is returned in class. It is very important that you spend time reworking questions you had difficulty with before looking at the exam key. If you are still having difficulty after consulting the key – please see me for help.

COURSE SCHEDULE
A Course Schedule that details the topics that will be covered each class is available on CANVAS.

* The learning objectives for each module are available on Canvas.

The course schedule is subject to change.

Student work submitted as part of this course may be reviewed by Oxford College and Emory College faculty and staff for the purposes of improving instruction and enhancing Emory education.

EMORY STATEMENT ON CIVIL DISCOURSE:
We believe the manner in which we interact with each other is critical to cultivating and maintaining a meaningful and effective intellectual environment. We encourage a climate of respect and inclusiveness that welcomes and embraces community members with diverse backgrounds and life experiences. We deliberately seek multiple perspectives and support the free and open exchange of ideas and civil discourse. We affirm the inherent dignity in all of us and we strive to maintain a climate of justice marked by respect for each other. Our community can only continue to thrive when we approach each conversation with an open mind and when each member can contribute fully.