Sample Syllabi – Subject to Change
Pathways in Molecular Engineering

Instructors:

Prof. Aaron Esser-Kahn

Prof. Shrayesh Patel

Dr. Xiaoying Liu

Meeting Time and Location:

Lectures: 9:00 am - 11:30 am
Labs-Experiments: 1:00 pm – 4:00 pm
Labs-Computation: 1:00 pm – 4:00 pm

Course Description:

The summer program of Pathways in Molecular Engineering at the University of Chicago is an immersion course for motivated high-school students to gain a general understanding and develop critical skills in the emerging field of Molecular Engineering. It provides an overview of the basic components of molecular engineering across multiple disciplines of physical, chemical, computational, and engineering sciences. Drawing upon examples of engineering systems including dye-sensitized solar cells for energy conversion, this course introduces the design principles of modeling and optimization at the molecular level and their applications in technological problem-solving. Students learn the fundamental concepts and develop important engineering skills through lectures, laboratory experiences, molecular modeling, field trips, and discussions. The program will lead participants beyond the boundaries of traditional scientific disciplines to engage in the lateral, multidisciplinary thinking that is required to develop effective solutions to real-world technological challenges.

Course Goals:

- Gain a general understanding of key principles behind engineering a system to seek a desired outcome
- Understand how to integrate scientific knowledge with engineering tools to develop materials and design devices
- Learn how to modify materials and operational conditions to optimize a specific design parameter and improve a system or process
- Establish broad knowledge on molecular engineering research methods through hands-on laboratory experience and molecular modeling
- Develop critical thinking skills through the integration of reading, discussion, and experiments
- Work effectively in a team to develop collaboration skills to achieve team objectives

General Course Structure:

Week 1:

- **Mornings (9 am – 11:30 am)**

Lectures, discussions and problem-solving in class

- **Afternoons (1:00 pm - 4:00 pm)**

Instructional laboratory sessions

Students work in small groups to construct and characterize a dye-sensitized solar cell

- **Field trip** to tour Argonne National Laboratory facilities

Week 2:

- **Mornings (9 am – 11:30 am)**

Lectures, tutorials and discussions on molecular modeling and optimization

- **Afternoons (1:00 pm - 4:00 pm)**

Hands-on computation sessions for model implementation

Week 3:

- **Mornings (9 am – 11:30 am)**

Lectures, discussions and problem-solving in class

- **Afternoons (1:00 pm - 4:00 pm)**

Instructional laboratory sessions

Lab teams test new materials, parameters and methods to optimize performance of dye-sensitized solar cells

- **All-day lab on final day** for optimization of devices and competition for highest device performances and most accurate predictions

Texts:

- Engineering Fundamentals: An Introduction to Engineering, 5th Edition, by Saeed Motavani

https://www.amazon.com/Engineering-Fundamentals-Introduction-Activate-Learning/dp/1305084764/ref=dp_ob_title_bk

- Dye Sensitized Solar Cells, Edited by Kuppuswamy Kalyanasundaram

https://books.google.com/books?id=1n1QC2snf-AC&lpg=PR17&dq=dye%20sensitized%20solar%20cells&lr&pg=PR9#v=onepage&q&f=false

https://catalog.lib.uchicago.edu/vufind/Record/11567583

Course Website:

The course syllabus, class schedule, homework assignments, class updates, and other course information are available through the MENG 10100 Canvas course site.

Grading Policies:

- Class participation: 15 %
- In-class quizzes: 15 %

- Homework problem sets: 20 %
- Laboratory participation: 20 %
- Laboratory homework and report: 30 %

Class participation:

During class, all students are required to participate by answering questions, participating in class discussion, and working in small groups.

In-class quizzes:

A number of in-class quizzes will be given at the beginning of the lecture that are based on the readings students are assigned to finish and students' understanding of the previous lecture material.

Homework problem sets:

Homework assignments will be distributed and must be submitted at the beginning of the class on the dates indicated. Late assignments will not be accepted without prior approval by the instructors. These problems will require the use and application of mathematics, chemistry and physics to solve with the goal of helping students learn mathematical skills and develop critical abilities for problem analysis.

Laboratory participation:

Students are expected to arrive on time, attend all lab sessions, and actively participate in all experiments. Students are required to follow safe laboratory practices at all times and perform adequate housekeeping duties (proper disposal of waste, organization of equipment and tools, and cleaning benchtops) to keep their working space clean and tidy.

Laboratory homework and report:

All students are required to solve a number of problems that are related to the lab projects and submit a lab report on the experiments you have completed, observations and measurements made, data analysis, and conclusions.

Academic Ethics:

Students will be held to the same scholarly standards as those with the University of Chicago academic community. It is an unfortunate fact that on occasion, students either intentionally or unintentionally claim the work of others as their own. We will provide you with detailed information on what

constitutes plagiarism on the first day of class, as well as the APA citation style we will be using in this course. All students are responsible for reading these materials and asking whatever clarification questions are necessary to ensure that they are correctly citing the ideas they borrow from other sources.

Additionally, unless otherwise explicitly indicated on the assignment, students should assume that they should work on assignments independently without the assistance of their peers.

Finally, students are expected to behave in a professional manner with other participants at all times. Failure to do so can lead to expulsion from the course and being asked to leave the class.

Disability Statement:

The University of Chicago is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the University's programs or services, you are encouraged to contact Student Disability Services as soon as possible. To receive reasonable accommodation, you must be appropriately registered with Student Disability Services. Please contact the office at 773-834-4469/TTY 773-795-1186 or email disabilities@uchicago.edu or visit the website at disabilities.uchicago.edu.

If you require any accommodations for this course, please provide us as early as possible with a copy of your Accommodation Determination Letter (provided to you by the Student Disability Services office) so that you may discuss with us how your accommodations may be implemented in this course. We are more than happy to provide any kind of accommodation that will help you succeed in this program.