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CHEN 4838 / 5838 – Drug Delivery

Course Syllabus – Fall 2024

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CLASS HOURS: MW 3:25-4:40pm, JSCBB (BIOT) A108

OFFICE HOURS: Tu 3:30-5:00pm (Trese, JSCBB B432) | Th 2:30-4:00pm (Shields, JSCBB D218)

TEXT: *Nanoparticles for Biomedical Applications*, 1st Edition - Elsevier (Optional)
Required reading will be uploaded prior to class

COURSE DESCRIPTION

This course delves into the intricate and expanding world of drug delivery systems, focusing on emergent concepts, technologies, and applications used in pharmaceutical sciences. Students will explore the principles behind drug delivery, including the design, development, and optimization of delivery systems to enhance therapeutic efficacy and minimize adverse effects. The course begins with a broad overview of drug delivery fundamentals, covering essential topics such as pharmacokinetics, pharmacodynamics, and drug targeting strategies. Emphasis is placed on understanding the physiological barriers to drug delivery and the various approaches used to overcome those barriers. Students will examine a range of drug delivery systems, including liposomes, micelles, implants, organic and inorganic nanoparticles, among others. Through case studies and classroom discussions, students will evaluate the advantages, limitations, and applicability of each system in delivering drugs to specific target sites within the body. Special attention will be given to current trends in drug delivery, such as delivery of gene editing technologies, immunotherapy, and personalized medicine. Students will learn to critically analyze primary research articles and explore the ethical and regulatory considerations associated with novel drug delivery approaches. Throughout the course, students will have the opportunity to work on group projects to propose innovative solutions to real-world drug delivery challenges. By the end of the course, students will gain a comprehensive understanding of fundamental and advanced principles in drug delivery and be equipped with the knowledge to contribute to the development of next-generation drug delivery systems.

COURSE REQUIREMENTS

This class is geared toward first-year graduate and senior/junior-level engineering undergraduate students. There are no pre/corequisites for graduate students. Biology for Engineers (CHEN 2810) is a mandatory prerequisite for undergraduate students. Biomaterials (CHEN 4805) or Materials (CHEN 4440) is a pre/corequisite for undergraduate ChBE majors and Biomaterials (BMEN 2010) is pre/corequisite for undergraduate BME majors.

COURSE GRADES	CHEN 4838 (UG)	CHEN 5838 (Grad)
A. Muddiest Points	50	50
B. Reading Quizzes	100	100
C. Journal Discussions	150	150
D. Homework	200	200
E. Lecture Quizzes	200	200
F. Final Project	300	400
Total	**1000**	**1100**

METHODS OF EVALUATION

A. **Muddiest Points (50 points):** Muddiest Points allows students to identify course concepts that were confusing or unclear. Each Muddiest Point will be submitted on Canvas by Wednesday at 11:59pm (see Course Schedule for due dates). Each submission is worth 5 points; and students may earn up to 50 points total. Submissions are graded primarily on participation. There is no limit to the number of questions that can be submitted. Late submissions will not be accepted. If a student does not have a question, they must instead submit a brief description of something interesting they learned.

B. **Reading Quizzes (100 points):** Reading quizzes cover journal articles and concepts related to drug delivery. Reading quizzes are due on Canvas before the start of class on the day the article is discussed (see Course Schedule for due dates). Reading quizzes are open to notes and online resources, but must be completed individually.

C. **Journal Discussions (150 points):** This course is largely built on in-class discussions on the assigned journal articles. For each journal article discussed, your group will provide answers to questions posed during lecture. Attendance and participation will be used to calculate the final grade. Students are allowed to miss one Journal Discussion without penalty.

D. **Homework (200 points):** Homework assignments will cover concepts primarily from lectures. Assignments will be posted about two weeks before the due date. Homeworks must be completed alone and submitted through Gradescope by 11:59pm on Fridays (see Course Schedule for due dates). The top 4 of 5 scores will be used to calculate the final grade. Answers will be posted to Canvas after the due date.

E. **Lecture Quizzes (200 points):** Lecture quizzes will be given at the beginning of certain class periods (see Course Schedule for dates). Quizzes will be in person and closed to notes and online resources. They will primarily cover content from lectures since the previous quiz (quizzes are non-cumulative). Answers to the homework related to the quiz will be posted so that students can gain practice. Quizzes will be multiple choice and short answer, with a 15-minute time limit. The top 4 scores of 5 quizzes will be used to calculate the final grade. Answers will be posted to Canvas approximately 1 week afterwards.

F. **Final Project (300 – 400 points):** In lieu of a final exam, this course will culminate with a final project. Students will work in groups. Each group will design a drug delivery start-up company and deliver a high-level pitch for the company as if they were proposing their work to a scientific board. This assignment comes in four parts with due dates spread throughout the semester.

COURSE MATERIALS

Canvas will contain announcements, supplementary material, lecture material, homework assignments, reading assignments, grades, solutions, etc.

DEADLINES AND GRADE PENALTIES

- Assignments turned in after the deadline will be counted for 50% of possible points for 24 hours after the due date/time.
- *No credit* will be given for assignments turned in more than 24 hours after the due date/time.
- All grade contesting must occur via email to the TA within one week of their return date/time to the class; any contesting after this window will not be considered.

LEARNING OBJECTIVES

By engaging in class, this course will help you:

- Develop an understanding of the principles governing drug delivery systems;
- Understand key biological barriers that must be overcome to enable drug delivery;
- Apply principles of pharmacokinetics and pharmacodynamics to predict performance;
- Critically analyze literature to evaluate formulation strategies and experimental design;
- Identify real-world problems and apply core principles to address those problems;
- Learn the art of persuasive scientific writing and peer review;
- Sharpen problem-solving abilities and communication skills;
- Enhance ability to work in teams.

COURSE EXPECTATIONS

- Attend all classes and be on time.
- Cell phones are powered off during class; computers and tablets are allowed for notetaking.
- Participate in class by answering—and asking—questions.
- Complete reading assignments prior to class and complete homework assignments on time.
- Think critically about applying learned topics to current and emerging issues in society.

ABET STUDENT OUTCOMES

This course will provide students with:

- An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics;
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental and economic factors;
- An ability to communicate effectively with a range of audiences;
- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives;
- An ability to acquire and apply new knowledge, using appropriate learning strategies; and
- A working knowledge of advanced biological sciences.

CLASSROOM BEHAVIOR

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on classroom behavior and the Student Conduct & Conflict Resolution policies.

REQUIREMENTS FOR COVID-19

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the

policy on classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you miss a class due to illness or quarantine, please contact me in advance to receive a recording of the missed lecture.

ACCOMMODATION FOR DISABILITIES
If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

PREFERRED STUDENT NAMES AND PRONOUNS
CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

HONOR CODE
All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website.

SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION
CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu. Information about university policies, reporting options, and the support resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their

rights, support resources, and reporting options. To learn more about reporting and support options for a variety of concerns, visit Don't Ignore It.

RELIGIOUS HOLIDAYS
Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance.

See the campus policy regarding religious observances for full details.