Drug Design, Development and Delivery
Syllabus

Date	Topic	Speaker	Reading
Jan 10	Challenges of drug design, development and delivery	Bommarius, Prausnitz	Reading
Jan 12	Current practice of developing new drugs	Bommarius, Prausnitz	Reading
Jan 17	Successful examples of drug design and development	Bommarius	Reading
Jan 19	Successful examples of drug delivery	Prausnitz	Reading
Jan 24	Tutorial on transport phenomena	Prausnitz	Reading
	Tutorial on bioorganic chemistry	Bommarius	Reading
	DRUG DESIGN		
Jan 26	Drug characteristics; Sources of drugs	Powers	
	QUIZ and HOMEWORK due at beginning of class		
Jan 31	Structure-based drug design	Powers	Reading
Feb 2	High throughput screening	Powers	Reading
Feb 7	The story of four enzymes	Powers	Reading
	DRUG DEVELOPMENT		
Feb 9	Chirality; Chemo- and biocatalysis; Pharma process development (Tamiflu)	Bommarius	Reading
	QUIZ and HOMEWORK due at beginning of class		
Feb 14	Hydrolyses & condensation reactions; Thermodynamic & kinetic control; Peptides	Bommarius	Reading
Feb 16	Redox reactions; Oxidoreductases; Phenylalkanol drugs; Steroids	Bommarius	Reading
Feb 21	Additions; Development of a protein therapeutic	Bommarius	Reading
Feb 23	Development of vaccines (influenza vaccine)	Bommarius	Reading
	HOMEWORK due at beginning of class; SOLUTIONS		

	DRUG DELIVERY		
Feb 28	Conventional delivery methods; Pharmacokinetic models	Prausnitz	Reading
	QUIZ at beginning of class; SOLUTIONS		
Mar 2	Polymeric controlled release systems	Prausnitz	Reading
Mar 7	Transdermal delivery	Prausnitz	Reading
Mar 9	Ocular and other routes of delivery	Prausnitz	Reading
Mar 14	Future directions in drug delivery	Prausnitz	Reading
	HOMEWORK due at beginning of class; SOLUTIONS		
Mar 16	Pharmaceutical marketing	Thompson, Marketrx	Reading
	Introduction to testosterone patch	Bommarius, Prausnitz	Reading
	QUIZ at beginning of class		
	CASE STUDY I: TESTOSTERONE PATCH		
Mar 28	Chemical synthesis of testosterone	Team 1	Reading
	Microbial synthesis of testosterone synthesis	Team 2	Reading
Mar 30	Transdermal patch delivery of testosterone	Team 3	Reading
	Other methods of testosterone delivery	Team 4	Reading
Apr 4	Broader implications: steroid abuse	Bommarius, Prausnitz	Reading
	Introduction to ocular dorzolamide	Bommarius, Prausnitz	Reading
	CASE STUDY II: OCULAR DORZOLAMIDE		
Apr 6	Dorzolamide synthesis by conventional chemoenzymatic synthesis	Team 5	Reading
	Dorzolamide synthesis by novel chemoenzymatic routes	Team 6	Reading
Apr 11	Topical dorzolamide delivery to the eye	Team 7	Reading
	Structure-permeability relationships for ocular delivery	Team 8	Reading
Apr 13	Broader implications: race-based health disparities	Bommarius, Prausnitz	Reading

	Introduction to leuprolide implant	Bommarius, Prausnitz	Reading
	CASE STUDY III: LEUPROLIDE IMPLANT		
Apr 18	Solid-state synthesis of leuprolide	Team 9	Reading
	Enzymatic synthesis of leuprolide	Team 10	Reading
Apr 20	Polymeric controlled release of leuprolide	Team 11	Reading
	Protein stability in controlled release systems	Team 12	Reading
Apr 25	Chemical vs. enzymatic synthesis of nifedipine	Team 13	Reading
	Broader implications: FDA approval process	Bommarius, Prausnitz	Reading
Apr 27	Wrap-up of case studies and course review	Bommarius, Prausnitz	

May 3 Final Exam 8:00 - 10:50 am

Drug Design, Development and Delivery
Course Administration

Class Meetings
TTh 9:30 - 11:00
ES&T Building, Room L1105

Office Hours
By appointment

Prerequesites
Biochemistry (CHEM 3511 or CHEM 4511)

Philosophy
The course introduces the student to drug design, development, and delivery in the context of the proces of generating pharmaceutical therapies. The curriculum is designed to include an interdisciplinary mix of ideas that emphasize the intersection of engineering and chemistry/biochemistry applied to pharmaceuticals.

After an introduction to the critical issues in drug design, development, and delivery, the course focuses on a series of case studies of actual drug products involving written and oral student reports. Students are expected to participate heavily in class discussions and project preparation/presentation. Class attendance and familiarity with the assigned readings are required.

Objectives
After this class, students should be able to:

1. appreciate critical issues, perform analysis, and make quantitative calculations related to drug design
2. appreciate critical issues, perform analysis, and make quantitative calculations related to drug development
3. appreciate critical issues, perform analysis, and make quantitative calculations related to drug delivery
4. integrate concepts from drug design, development and delivery and appreciate their interdependence
5. understand the different phases of the pharmaceutical process
6. appreciate the role of alternative methods and broader implications of the pharmaceutical process
7. communicate with professionals in the pharmaceutical community.

Class Attendance and Participation
Although attendance will not be taken, you are expected to come to class, participate in class discussions, and be responsible for all material presented there. If you miss class, you must find out what was presented and obtain any handouts or other materials you may have missed. Written and oral assignments directly reflect the material discussed in class. Your grade is based in part on class participation.

Assignments
There will be three types of classwork assignments: homework assignments, written reports, and oral reports. The latter types of assignments will involve group efforts.

- homework
- written report

- oral report

There will also be quizzes after each module and a final exam; they will be in-class, short-answer or essay type, and closed book/closed notes.

Homework and written report assignments are due at the beginning of class. Oral reports are presented during regular class meeting times. Although no credit is given for late work, it may be critiqued at the instructor's discretion. Discussion of homework assignments with classmates is encouraged, but all submitted assignments must be your own. Plagiarism and other Honor Code violations are taken very seriously and reported to the Dean of Students.

All homework and written report assignments should be on single-sided, 8.5" x 11" paper that has been stapled together. Written reports and lengthy text other than calculations in homework assignments should be typed with 12-point font and 1.5 line spacing (hand-written text will not be accepted). Written reports must also be submitted electronically.

Deadline Conflicts

Late homework assignments are not accepted unless special arrangements have been made with the instructor in advance. If a medical emergency prevents you from turning in an assignment, a letter from the health center is required. Other cases may be referred to the Dean of Students. As soon as you know that you will miss or have missed an assignment due date, you are requested to notify one of the instructors (a telephone or email message is fine).

Grading

Class Participation: 15%
Homework assignments: 10%
Written reports: 15%
Oral reports: 15%
Quizes: 15%
Final Exam: 30%

Note on cross-listing

This course draws material from chemical engineering, biomedical engineering, and chemistry, as well as other disciplines. It is a highly interdisciplinary course. During the previous offerings of the course, there have been students from ChBE, BMED, and CHEM enrolled. For these reasons, we believe it is appropriate to cross-list the course in these three Schools.

Note on offering separate undergraduate and graduate courses

This class has content suitable for both undergraduate and graduate students. Lectures for the undergraduate and graduate courses are concurrent, but assignments and grading are different. For example, graduate students receive additional questions on their homework; these questions are open-ended and involve significant independent literature research. Graduate students are also held to higher standards and expectations during their in-class project presentations, post-presentation questioning, and written reports. Grading of undergraduate and graduate students is done separately, with each class having its own grading curve. This is how the class has been taught previously and it worked well.