



PHARM 610
ADVANCED DRUG DELIVERY SYSTEMS
(LEC A1 Fa20)

Fall 2020

Course Weight: 3

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Office Hours: By appointment

Course Description

The focus of this course is on the design and development of novel delivery systems for various treatment and diagnostic applications. A particular attention will be paid to the physicochemical principles behind the development of different drug delivery systems, their biological application and significance. Emphasis is given to polymer based systems and assembled nano-carriers for the delivery of therapeutic drugs, proteins, vaccines and genes. Prerequisite: Consent of Faculty.

Grading

Title	Weight	Date	Type
Critical Review	15%	To be determined	Assignment
In class assignments	10 %	To be determined	Assignment
Final	40%	To be determined	Exam
Midterm	35%	2020-10-20	Exam

Additional Information about Assessments

Critical Review

The student will be responsible for critical review of a recently published article (within the last 5 years) and writing a 1 to 2-page report. The report should include a paragraph summarizing the study and then major and/or minor points for improvement of the manuscript. The paper to be reviewed can be selected by the instructor or the student. The papers will be discussed during Journal club sessions outside of the classroom schedule.

In class assignments

Three to four assignments (written questions) on different subjects in the course will be provided by the instructors. Each assignment will have 10 marks and the average of the assignment marks will be used as the final mark in this section.

Midterm

Format: Written

Final

Not cumulative, but certain information from the first part of lecture would be required.

Format: Written

Letter Grading

As per University policy (see [Evaluations Procedures and Grading System of the University Calendar](#)), final grade assessment will be based on consideration of absolute achievement and relative performance in the class.

Course Schedule

Lecture location: On line

Lecture schedule: Tue Thu 02:00 PM - 03:30 PM

Title	Date	Instructor	Topic(s)
Session 1	2020-09-01	Dr Lavasanifar	Introduction to Advanced Drug Delivery
Session 2	2020-09-03	Dr Lavasanifar	Modified Release Dosage Forms
Session 3	2020-09-08	Dr Vakili	Introduction to Polymer Science
Session 4	2020-09-10	Dr Vakili	Introduction to Polymer Science
Session 5	2020-09-15	Dr Vakili	Introduction to Polymer Science
Session 6	2020-09-17	Dr Vakili	Introduction to Polymer Science
Session 7	2020-09-22	Dr Lavasanifar	Polymer Based Drug Delivery Systems
Session 8	2020-09-24	Dr Lavasanifar	Polymer Based Drug Delivery Systems
Session 9	2020-09-28	Dr Lavasanifar	Polymer Based Drug Delivery Systems
Session 10	2020-10-01	Dr Lavasanifar	Polymer Based Drug Delivery Systems
Session 11	2020-10-06	Dr Lavasanifar	Nano-Drug Delivery
Session 12	2020-10-08	Dr Lavasanifar	Nano-Drug Delivery
Session 13	2020-10-13	Dr Lavasanifar	Nano-Drug Delivery
Session 14	2020-10-15	Dr Lavasanifar	Nano-Drug Delivery
Session 15	2020-10-20	Dr Lavasanifar	Midterm
Session 16	2020-10-22	Dr Vakili	Nano-Drug Delivery Systems: Characterization
Session 17	2020-10-27	Dr Emami	Pharmacokinetic Considerations in Drug Delivery
Session 18	2020-10-29	Dr Emami	Pharmacokinetic Considerations in Drug Delivery
Session 19	2020-11-03	Dr Emami	Pharmacokinetic Considerations in Drug delivery
Session 20	2020-11-05	Dr Doschak	Immuno-targeting
Session 21	2020-11-10	Dr Doschak	Immuno-targeting
Session 22	2020-11-12	Dr Wishart	Protein Delivery
Session 23	2020-11-17	Dr Wishart	Protein Delivery

Session 24	2020-11-19	Dr Uludag	Gene Delivery
Session 25	2020-11-24	Dr Uludag	Gene Delivery
Session 26	2020-11-26	Dr Agrawal	Vaccine Delivery
Session 27	2020-12-01	Dr Agrawal	Vaccine Delivery
Session 28	2020-12-03	Dr Wuest	Theranostics
Session 29	2020-12-08	Dr Wuest	Theranostics

Additional Teaching Information

Outline:

1. Principles of advanced drug delivery (3 hours)

Rationale for the development of advanced delivery systems and its history. Overview of terminology, and fundamentals of controlled drug delivery systems (chemical and physical approaches), release mechanisms (diffusion, dissolution, degradation, osmosis) and release kinetics.

2. Pharmacokinetic considerations in drug delivery (4.5 hours)

Zero- and first- order kinetics, Kinetics of saturable processes, principles of basic pharmacokinetics, pharmacokinetic parameters for drug input and disposition, in vitro/ in vivo assessment of drug binding and its application in drug delivery systems, and review of the pharmacokinetics of drug delivery systems, new methods for determination of bioequivalence in nano-drug delivery.

3. Introduction to polymer science (6 hours)

Terminology, classes of polymers, chain architecture, polymerization methods, polymer properties (molecular weight and molecular weight distributions, polymer dimensions and conformation, morphology, configuration, crystallinity, polymer dissolution, rheology, mechanical and thermal properties); polymer characterization, measurement of molecular weight, method in polymer characterization (NMR, FT-IR, Mass spectroscopy, GPC and XRD)

3. Polymers in drug delivery (6 hours)

Design, characterization, drug loading and release mechanism in polymeric based delivery. Diffusion based, degradation based and stimulus triggered polymeric delivery systems. Medical uses, with emphasis on drug delivery, Structure-Property Relationships. Application of natural polymers for drug delivery. Role of PEG in drug delivery and surface modifications.

4. Principles of drug targeting (3 hours)

Overview of terminology, passive, active and physical targeting, drug targeting from different routes of drug administration. The fate of pharmaceutical dosage forms in the body, and time

course of pharmaceutical dosage forms in the body with reference to their absorption, distribution, metabolism, and elimination, rate processes, the physiochemical influences on absorption, distribution, metabolism, and elimination and formulation factors involved in drug delivery and availability.

5. Micro and nano-delivery systems (3 hours)

Introduction to liposomes, preparation, liposome pharmacokinetics/biodistribution, clinically approved liposomal drugs, targeted liposomal drugs. Polymer based nano and micro delivery systems. Polymeric nanoparticles, polymeric micelles, dendrimers, polymeric vesicles, etc. characterization of nano-drug delivery systems (Microscopic methods, SEM, TEM, AFM, DLS, SLS).

6. Gene delivery (3 hours)

Early approaches, viral and non-viral delivery systems for *in vitro* and *in vivo* delivery of genes and nucleic acids (oligonucleotides; aptamers; spiegelmers; RNA).

7. Peptide and protein delivery (3 hours)

Peptide and protein catabolism and metabolism, protein denaturation processes and energetic, protein stabilization techniques (chemistry & theory), targeted protein delivery, the challenge of oral/nasal delivery

8. Vaccine delivery (3 hours)

Overview of the immune responses, prophylactic and therapeutic vaccines for cancer and infectious diseases, tolerogenic vaccines, challenges in vaccine formulation and delivery, vaccine delivery to dendritic cells, pharmaceutical vaccine delivery systems.

9. Immunotargeting (3 hours)

Naked antibody targeting, chemically Modified Antibody conjugates of drugs, isotopes and biologicals, Recombinant antibodies, immuno-liposomes

10. Theranostics (3 hours)

Overview of imaging techniques; Imaging biomarkers and radio-therapeutics for targeted imaging and treatment of diseases

Policy

University Policy

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behavior (online at www.governance.ualberta.ca) and avoid any behavior which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence.

Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Policy about course outlines can be found in [Course Requirements, Evaluation Procedures and Grading](#) of the University Calendar.

Faculty Policy

[Territorial Acknowledgement](#)

The University of Alberta acknowledges that we are located on Treaty 6 territory, and respects the histories, languages, and cultures of First Nations, Metis, Inuit, and all First Peoples of Canada, whose presence continues to enrich our vibrant community.

L'Université de l'Alberta reconnaît qu'elle est située sur les terres du Traité 6 et respecte les histoires, les langues et les cultures des Premières Nations, des Métis, des Inuits et de tous les peuples autochtones du Canada, dont la présence continue d'enrichir notre communauté si vivante.

[Pharmacy Code of Professionalism](#)

Students are expected to abide by the Faculty's Pharmacy Code of Professionalism at all times. Lapses in professional conduct may result in the issuing of a Professional Accountability Form. If issued, these forms will be kept on student records for 2 years.

[Accessibility Resources and Accommodations](#)

(Formerly: Student Accessibility Services (SAS))

Student accommodations are offered in accordance with the [Faculty of Pharmacy and Pharmaceutical Sciences \(FoPPS\) Essential Skills policy](#). Accommodations are not offered for quiz assessments. Students requiring accommodations for major assessment activities must seek to register with [Accessibility Resources](#) at the beginning of each academic term. Accessibility Resources will work with the FoPPS (Office of Student Services) to determine the nature of any accommodation that will be granted. Once approved, Accessibility Resources will provide students and the Faculty with a "Letter of Accommodation". The Faculty will share accommodation requirements with primary instructors and/or lab instructors. Those students who need accommodated exams must provide the primary instructor and/or the lab instructor with an Accessibility Resources Exam Instructions & Authorization Form one week before each exam. You are encouraged to make an appointment with the instructor to discuss the required accommodations.

For students who write exams with accommodations at Accessibility Resources, please be cognizant of their deadlines and regulations. If you fail to meet these deadlines or follow the procedures, the result is most likely that Accessibility Resources will be unable to provide the necessary space and/or services you require. In these situations, the FoPPS does not have the resources to provide disability-related exam accommodations, and you will be invited to write your exams with peers during the allotted time in the assigned room.

Deferred Final Exams

The Faculty of Pharmacy and Pharmaceutical Sciences provides re-examinations according to [Academic Regulations about Attendance](#) for students who miss a final exam due to incapacitating mental and/or physical illness, severe domestic affliction or for circumstances as described in the University's Discrimination, Harassment and Duty to Accommodate Policy (including religious belief).

Students who miss an exam for acute unexpected reason as described above must notify their instructor and Student Services within 48 hours of missing the exam or as soon as they are able. Use the [Deferred Final Exam Request Form](#) to notify Student Services of missed exams. Deferrals for religious reasons must be brought to the attention of Student Services within 2 weeks of the start of Fall or Winter classes and within 3 days of the start of Spring/Summer classes.

For students who miss more than one Fall final exam, additional dates will be scheduled in the period between January XX and the start of Reading week or between May XX and June XX on an as needed basis.

If you have missed an assessment that is not a final examination (e.g. Midterm), an [Application for Excused Absence from Term Work](#) should be completed and provided to the Instructor within 2 business days, or as soon as you are able to physically come in to the University.

Equality, Equity and Respect

The Faculty of Pharmacy and Pharmaceutical Sciences is committed to providing an environment of equality and respect for all people within the university community, and to educating faculty, staff and students in developing teaching and learning contexts that are welcoming to all. The faculty recommends that staff and students use inclusive language to create a classroom atmosphere in which students' experiences and views are treated with equal respect and value in relation to their gender, racial background, sexual orientation and ethnic backgrounds. In order to create a thoughtful and respectful community, you are encouraged to use gender-neutral or gender-inclusive language and to become more sensitive to the impact of devaluing language.