PHM 387M Physical and Chemical Principles of Drugs  
Fall 2019

Course Coordinator: Debadyuti (Rana) Ghosh  
Pronouns: He, Him  
Email: dghosh@austin.utexas.edu  
Phone: 512-471-7390  
Office: PHR 4.214F  
Office Hours: M 2-3pm (virtual); by appointment

Course Faculty: Dr. Maria Croyle  
Email: macroyle@austin.utexas.edu  
Phone: 512-471-1972  
Office: PHR 4.214D  
Office Hours: T 4-6 PM and by appointment

Course Unique Number(s): 58335

Classroom(s): Monday PHR 2.110  
Friday UTC 2.112A

Class Days/Times: Monday 9-11 AM (PHR 2.110)  
Friday 9-10 AM (UTC 2.112A)

Teaching Assistants:

Academic Assistant:
Course Description:
Many significant advances made in the pharmaceutical sciences in recent years are in large part attributable to the accelerated development of knowledge of the molecular structure and physicochemical properties of drugs.

This course is designed to review certain concepts presented in various general and physical chemistry courses taken in the pre-pharmacy curriculum and address how these influence the safety, effectiveness and reliability of medicinal products.

Course Prerequisites/Co-Requisites:
Prior to enrolling in the course, students are to be in the first professional year of the pharmacy curriculum and have successfully completed the prerequisite mathematics and chemistry courses including algebra, calculus, and general chemistry and will be held responsible for understanding the concepts presented in these previous courses. In addition, students must also be concurrently enrolled in PHM 187P Physical and Chemical Principles of Drugs Laboratory.

Course Learning Objectives:
After completing this course, students should be able to:

* understand the rationale and theory used to describe and monitor biological (drug absorption) and physical (drug solubility, drug degradation) processes routinely encountered in pharmaceutical practice.

* critically evaluate given data sets to identify parameters that dictate how safe, effective and reliable a given medicinal preparation will be and how these could be altered to improve drug efficacy in given situations.

* accurately and adeptly perform calculations based upon general chemical principles to predict how medicinal preparations will perform in the body as well as in a given dosage form on the pharmacy shelf.

* appreciate that this knowledge will not only form a basis for understanding concepts introduced later in the curriculum but is critical for the evaluation and preparation of any dosage form prior to dispensing them to a patient.

* effectively interface with practitioners and basic scientists involved in formulation development and preparation of both novel and traditional medicinal preparations.
Classroom Expectations:
This course is designed and structured to provide you with the BEST training in pharmaceutics in the country. We are a nationally and internationally recognized program, and we are ensuring that you get the best education to reflect this standard of excellence.

You will be asked to take responsibility to acquire basic information (facts, principles, concepts) by reading Assignments that are posted on Canvas Prior to coming to class. During class time, these principles will be applied to the practice of pharmacy and you will gain practice sharpening problem solving skills and making patient centered decisions using these basic principles of chemistry and math. Time during the Monday class period will also be spent addressing any conceptual questions that you may have after completing the reading assignments.

Cell Phones: Cell phones must be put away during class. For the lecture on Mondays, we will have a break half way through the lecture and this time may be used to catch up on texts and e-mail.

Laptops: Laptop computer use during class is strictly limited to viewing lecture handouts, taking notes and working on assigned problem sets.

Classroom Protocol:

Attendance: To be successful in the course and since assessments completed during class time will contribute to your course grade, class attendance is expected.

Monday Session: Start at 9 AM sharp!
It is important that you arrive prepared and on time as assessments of your understanding of assigned Pre-Readings will occur in the first 10-15 minutes of class.

9:50 AM - 10 minute break
10:00 AM - Continuation of lecture
10:50 AM - Adjournment

Friday Session: The lecture and the laboratory sessions of this course will be run concurrently on Fridays and serve as team-based problem solving sessions. They will not only sharpen your problem solving and decision making skills, they will also provide you with the opportunity to interact with your fellow classmates in a professional manner. Problems solved during this session will be reflective of problems you would encounter in practice and on mid-term exams. For more details about the structure and expectations for the Friday class time, see the syllabus for PHM 187P.

To get the most out of this course
a. Be on time. If you arrive early, sit up front.

b. Be quiet when entering the lecture room if class has already started. Your colleagues will thank you for not distracting them while they are taking the assessment on the assigned pre-readings and/or from hearing what is going on if lecture has started. If you arrive late during the pre-assessment you will not be given extra time to complete the
assigned questions.

c. Review your notes and Pre-Reading Materials prior to class and come prepared with questions!

d. If you are struggling specific concepts after attending class make time to visit Dr. Ghosh, Dr. Croyle, your Teaching Assistants and your Academic Assistant during their office hours! Students that have not done well in the course have not followed this last suggestion and, as a result, did not address deficiencies in understanding concepts until it was too late. We are here to help you!

Course Website:
This course uses Canvas, a Web-based course management system in which a password-protected site is created for each course. Canvas will be used to distribute course materials, to communicate, and to post grades. Canvas is available at http://canvas.utexas.edu. Support is provided by the ITS Help Desk at 475-9400 Monday through Friday 8 am to 6 pm.

Course Communications:
Official course communications will take place in class, through e-mail and on the course Canvas website. Students are advised to configure their Canvas settings to forward course announcements to their official e-mail address. Canvas uses only the e-mail address listed on the official University of Texas directory, so please check the University’s online directory to ensure your e-mail address is listed correctly.

Course Video Recordings:
A video capture system will be used in this course. The video streams are offered as a supplement to lecture attendance, not as a substitute. Therefore, if technical problems preclude recording the lecture, the lecture will not be re-recorded, but students are still responsible for the content of the lecture. Lecture recordings will be available to you for the balance of the semester unless otherwise specified. Do not expect to have access after the semester is over.

Faculty and students utilizing class video recordings should be careful to not compromise the privacy of either themselves or other users (http://registrar.utexas.edu/students/records/ferpa), or the rights of the presenter. Students are free to make their own recordings of lectures unless specifically prohibited from doing so by the presenter. Any additional distribution of College- or student-generated recordings (regardless of format) is prohibited without the written and signed permission of the presenter and students identifiable on the recording. Likewise, all course materials developed by the faculty member (handouts, PowerPoints, etc.) are the intellectual property of that faculty member and cannot be distributed further without the permission of that faculty member.

Viewing video-streamed recordings of lectures can be streamed on campus or can be viewed off-campus using a DSL broadband connection. Your faculty are not in a position to troubleshoot your video-streaming problems, so please do not ask them to do so; rather, you should access the LRC’s help website at https://www.utexas.edu/pharmacy/help/ to address those problems. You will find additional information about the lecture capture system or can report technical issues at http://sites.utexas.edu/phr-lrc/
Course Policies

Course Grading Policies:
**NOTE: You will receive a separate grade for 387M and 187P

Course Grade:

<table>
<thead>
<tr>
<th>Category</th>
<th>% of final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Reading Assessments</td>
<td>4</td>
</tr>
<tr>
<td>Midterm Exam 1</td>
<td>24</td>
</tr>
<tr>
<td>Midterm Exam 2</td>
<td>24</td>
</tr>
<tr>
<td>Midterm Exam 3</td>
<td>24</td>
</tr>
<tr>
<td>Final Exam (cumulative)</td>
<td>24</td>
</tr>
</tbody>
</table>

Letter grades will be assigned according to the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93-100%</td>
</tr>
<tr>
<td>A-</td>
<td>90-92%</td>
</tr>
<tr>
<td>B+</td>
<td>87-89%</td>
</tr>
<tr>
<td>B</td>
<td>83-86%</td>
</tr>
<tr>
<td>B-</td>
<td>80-82%</td>
</tr>
<tr>
<td>C+</td>
<td>77-79%</td>
</tr>
<tr>
<td>C</td>
<td>73-76%</td>
</tr>
<tr>
<td>C-</td>
<td>70-72%</td>
</tr>
<tr>
<td>D+</td>
<td>67-69%</td>
</tr>
<tr>
<td>D</td>
<td>60-66%</td>
</tr>
<tr>
<td>F</td>
<td>&lt;60%</td>
</tr>
</tbody>
</table>

Grades >0.5 will be rounded up to the nearest whole Percentage.

Excused Absences:
The only absences that will be considered excused are for religious holy days or extenuating circumstances due to an emergency. If you plan to miss class due to observance of a religious holiday, please let the course coordinator know at least two weeks in advance, preferably at the beginning of the semester. You will not be penalized for this absence, although you will still be responsible for any work you will miss on that day if applicable. Check with the course coordinator for details or arrangements.

Attendance of Professional Meetings:
It is the student’s responsibility to ASK permission IN ADVANCE if they plan to attend a professional meeting that would necessitate missing an exam, assignment, or other required course activity. It is at the discretion of the course coordinator as to whether to grant permission and allow the student to make up any missed work.
**Required Materials:**
The content of this course will require students to assess data and perform calculations. **Thus, all students must have a Texas Instruments TI-36X-Pro calculator.** There are **no exceptions** to this requirement. This calculator must be brought to all class periods in order to complete problems that are part of the in-class assessments and to complete assigned activities. **Calculators will not be provided.** Students that arrive with any other type of calculator will be turned away from all exams and will not be allowed to participate in pre-assessment assignments.

All students are required to have access to computers. Exams will be administered using the ExamSoft program and will require use of a laptop computer for all midterm examinations. A computer will also be useful for completing some of the problems during problem-solving sessions on Fridays.

**Recommended Materials:**
**There are no required textbooks for this course.** However, if a student would like additional information relative to the subjects covered in lecture, they are referred to the following texts:


---

**Exam Policies**

During exams, students are required to place their bags and other belongings in the front or side of the classroom. Therefore, this environment **MAY NOT** be conducive to carrying a concealed weapon (https://campuscarry.utexas.edu/). Please be advised that it is the licensed carrier’s responsibility to be compliant with the University’s policies.

Exams will begin promptly at their scheduled times. Students who complete the exam early will be required to remain in the exam room during, at least, the first half of the exam period. After the first half of the exam period is over, students who have completed the exam may leave the room after submitting their exam through the Examplify® site and showing Drs. Croyle, Ghosh or a TA they have successfully submitted their work. Students who arrive at the room after the exam has started will not be given additional time to complete the exam. Students who arrive at the examination room after the first half hour of the scheduled exam period is over will not be allowed to take the exam and will receive a score of ‘0’ for that exam.
ExamSoft®:
Students are responsible for the maintenance of their approved personal devices and Examplify® software. Students are required to bring approved personal devices and privacy screens for all exam and indicated assignments. Lack of preparation may result in an inability to take the exam, adjustments to course grades at the discretion of course coordinators, and/or an unprofessional conduct referral.

Any problems with Examplify® or ExamSoft® should be addressed via phone to Student Tech Support at 866.429.8889, email to support@examsoft.com, or live chat at www.examsoft.com. **Do not expect your Dr. Ghosh, Dr. Croyle or your teaching assistants to troubleshoot your technology issues.**

Students found improperly using ExamSoft® or Examplify® to gain unfair academic advantage are violating the College of Pharmacy Honor Code. Violations such as “academic dishonesty” and/or “professional misconduct” would include, but are not limited to, using a classmate’s login/password, tampering with exam files, and falsifying upload or download information, or any attempt to circumvent the security features of the software.

Students should refer to the ExamSoft® Policies Handbook for a complete listing of policies related to exams, quizzes and assignments.

Examination Dates:

The exams for PHM 387M will be given on the following dates at the following times:

<table>
<thead>
<tr>
<th>Date</th>
<th>Exam</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 27, 2019</td>
<td>Exam I</td>
<td>8:00-10:00 AM</td>
<td>UTC 2.112A</td>
</tr>
<tr>
<td>October 25, 2019</td>
<td>Exam II</td>
<td>8:00-10:00 AM</td>
<td>UTC 2.112A</td>
</tr>
<tr>
<td>December 6, 2019</td>
<td>Exam III</td>
<td>8:00-10:00 AM</td>
<td>UTC 2.112A</td>
</tr>
<tr>
<td>TBD</td>
<td>Final Exam</td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>

Exam Format:
Exam questions will cover material covered in pre-readings, in class, and/or during the 2 hour problem solving period on Fridays. Exam question format will include: multiple choice, true/false, fill-in-the-blank, matching and/or short answer questions.

Exam Return:
No examinations will be returned. Exam scores will be posted on the course Canvas site.

Exam Review: Students may review exams during the scheduled time for secure Exam Soft Review. In the spirit of supporting student success, students obtaining scores of 70 or less on a given exam will be required to fill out an Autopsy from during this session to identify weaknesses and discuss these with Dr. Ghosh or Dr. Croyle during the week following the exam. This is the only piece of paper that is allowed to leave the review area. You will not be able to review each midterm exam prior to taking the final exam. You are instead encouraged to review notes from exam review sessions held during the semester and from the review session for the final exam.

Exam Reconsideration Requests: Exam reconsideration requests must be submitted in writing to the course coordinator within one week of the date that the exam given. Students will not be able to leave the room with
question information to draft their reconsideration requests. Each request must be drafted and submitted electronically during the scheduled ExamSoft review session to the course coordinator. Comments about questions can also be made during the exam through the Exam Soft interface.

Final Exam Re-Examination Policy:
There is no final exam reconsideration requests or re-examinations allowed for this course.

Request for an Alternate Exam Time:
No allowances will be made for an exam being missed, other than documented illness or emergency, or by prior approval by the Course Coordinator. Unexcused absences from an exam may result in a grade of "zero" for that exam. Any student requesting accommodation for an upcoming exam must submit the request to the course coordinator using the online form posted on Canvas® at least 1 month prior to the exam. Note the new policy that an alternate exam time will be considered only if the student documents that they can’t be physically present on the date the exam is already scheduled.

Academic Integrity:
The “Statement on Scholastic Dishonesty of the College of Pharmacy” reads as such: “Pharmacy practitioners enjoy a special trust and authority based upon the profession's commitment to a code of ethical behavior in its management of patient affairs. The inculcation of a sense of responsible professional behavior is a critical component of professional education, and high standards of ethical conduct are expected of pharmacy students. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including failure of the course involved and dismissal from the College and/or the University. Since dishonesty harms the individual, fellow students, and the integrity of the University and the College of Pharmacy, policies of scholastic dishonesty will be strictly enforced in this class.”

Students are expected to work independently on all examinations and on all laboratory quizzes and problem sets (unless specifically instructed otherwise). Any student caught cheating will be given a “zero” on the assignment at a minimum. Any student suspected of dishonesty will be reported to the Dean of the College of Pharmacy and to the Dean of Students, as per University regulations. Students are expected to have read and understood the current issue of the General Information Catalog published by the Registrar’s Office for information about procedures and what constitutes academic dishonesty. Students are also expected to be familiar and abide by the College Honors Code, and will be expected to sign the Honors Statement at the end of each examination.

The Honors Statement will be summarized by the following statement on the login page for each exam through the Examplify® software:

“I have neither participated in nor witnessed any acts of academic dishonesty pertaining to this exam.”

Entering your assigned password and clicking the “Accept” button will serve as your agreement to this statement. If a student observes what might be dishonest conduct during an exam, they are encouraged to notify Dr. Croyle or Dr. Ghosh to discuss this issue.

Religious Holy Days
If you will miss a class, an examination, a work assignment or a project in order to observe a religious holy day, you must notify the course coordinator the first week of class so that arrangements for all such students can be made for the full semester.

Services for Students with Disabilities:
Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities at 471-6259 (voice) or 232-2937 (video phone)
or https://diversity.utexas.edu/disability/. All University rules concerning accommodations must be followed, including the student arranging for special accommodations prior to each examination. In the absence of such prearrangement, it will be assumed that the student is not requesting special accommodations for that exam, and will be expected to take the exam with the rest of the class at the regularly scheduled exam time.

Please provide a copy of the letter to the course coordinator and the office of the Associate Dean for Academic Affairs as soon as possible after receipt.

**Campus Carry**  Students should familiarize themselves with the information provided by the University regarding the implementation of “Campus Carry” legislation. You will find an information sheet specifically for students (as well as sheets for parents, visitors, faculty, and staff) at http://campuscarry.utexas.edu/info-sheets.

**Emergency Evacuation** Please refer to the Office of Campus Safety and Security (512-471-5767; http://www.utexas.edu/safety/) for recommendations regarding emergency evaluation.
<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/2</td>
<td>NO CLASS-LABOR DAY!</td>
<td>Ghosh</td>
</tr>
<tr>
<td>9/9</td>
<td>Thermodynamics</td>
<td>Ghosh</td>
</tr>
<tr>
<td>9/16</td>
<td>Gibbs Free Energy and Chemical Equilibrium</td>
<td>Ghosh</td>
</tr>
<tr>
<td>9/23</td>
<td>Intermolecular Interactions</td>
<td>Ghosh</td>
</tr>
<tr>
<td>9/30</td>
<td>Raoult’s Law and Colligative Properties</td>
<td>Ghosh</td>
</tr>
<tr>
<td>10/7</td>
<td>Osmosis and Tonicity</td>
<td>Ghosh</td>
</tr>
<tr>
<td>10/14</td>
<td>Chemical Kinetics, Drug Degradation, and Drug Stability</td>
<td>Ghosh</td>
</tr>
<tr>
<td>10/21</td>
<td>Chemical Equilibrium and Partitioning</td>
<td>Croyle</td>
</tr>
<tr>
<td>10/28</td>
<td>Drug Complexation and its Role in Solubility and Absorption</td>
<td>Croyle</td>
</tr>
<tr>
<td>11/4</td>
<td>No Class! Faculty at AAPS meeting</td>
<td></td>
</tr>
<tr>
<td>11/11</td>
<td>Common Ion Effect and Drug Solubility</td>
<td>Croyle</td>
</tr>
<tr>
<td>11/18</td>
<td>Acid Base Equilibria</td>
<td>Croyle</td>
</tr>
<tr>
<td>11/25</td>
<td>The Buffering Effect: Selection and Design of Pharmaceutical Buffers</td>
<td>Croyle</td>
</tr>
<tr>
<td>12/2</td>
<td>pH and Drug Solubility</td>
<td>Croyle</td>
</tr>
<tr>
<td>12/9</td>
<td>pH and Drug Absorption</td>
<td>Croyle</td>
</tr>
</tbody>
</table>
Course Outline:

1. Introduction
   1.1 What is Physical Pharmacy?
   1.2 Role of Physical Pharmacy in Daily Pharmaceutical Practice
      a) Examples of Drug Stability
      b) Examples of Drug Reliability
      c) Examples of Drug Safety

2. Thermodynamics
   2.1 Basic definitions
   2.2 State Functions
   2.3 Equilibrium and relation to State Functions
   2.4 Effect of temperature on equilibrium
      a) the van’t Hoff equation

3. Intermolecular Interactions
   3.1 Modes of Interaction
   3.2 Intermolecular Interactions and drug formulation and drug action
   3.3 Interactions in pure compounds
      a) boiling point
      b) melting point
   3.4 Relationship between melting and boiling point
      a) methods for prediction of melting and boiling point
   3.5 Interactions in Solution
      a) solubility
      b) partition coefficient
      c) Raoult’s Law
      d) colligative properties
      e) adjusting tonicity

4. Equilibria Important to the Pharmaceutical Sciences
   4.1 Chemical Reactions
   4.2 Complexation
      a) drug, receptor
      b) drug, protein
      c) drug, drug
      d) complexation and drug stability
   4.3 Vapor Pressure
      a) aerosols and Raoult’s Law
   4.4 Solubility
      a) electrolytes
      b) non-electrolytes

4.5 Partitioning of Non-Electrolytes
5. Acid/Base Equilibria
   5.1 Basic definitions
   5.2 Solving pH and buffer problems
       a) pH and buffer problems in physiology
   5.3 Effect of pH on solubility of drugs
   5.4 Effect of pH on drug partitioning and absorption

6. Chemical Kinetics
   6.1 Basic concepts
   6.2 Zero order processes
   6.3 First order processes
   6.4 Pseudo-order processes
   6.5 Effect of temperature on rate of a process
   6.6 Effect of pH on rate of a process