Meeting Time, Place, Credits

2.5 credits
Course Web Site:  https://moodle.umn.edu/
Term:  Fall 2017
Dates:  Wednesday (10:10 – 12:05pm) and Friday (9:05 – 11:00pm) of each week.
Location: Wednesday - MoosT 1-451 (TC)/163 L. Sci (Duluth); Friday – MoosT 1-451 (TC)/163 L.Sci. (Duluth)
Target audience: PDI

Course Instructional Team

Course Directors
Name: Changquan Calvin Sun, Ph.D.
Office location: WDH 9-127B
Phone: (612) 624-3722
Email: sunx0053@umn.edu
Preferred method of contact:  email or phone
Office Hours:  By appointment

Name: Joseph Johnson, Ph.D.
Office location: 253B SSB
Phone: (218) 726-8439
Email: jljohns3@d.umn.edu
Preferred method of contact:  email or phone
Office Hours:  By appointment
Course instructor
Name: Timothy Wiedmann, Ph.D.
Office location: WDH 9-127A
Phone: (612) 624-5457
Email: wiedm001@umn.edu
Preferred method of contact: email or phone
Office Hours: By appointment

Teaching Assistants:
UMTC
Name: Andrew Zhou
Email: zhoux760@umn.edu
Office hours: (WDH 9-104): Tuesday 1:00 – 2:00pm, Wednesday 3:30 – 4:30pm

Name: Wenqiu Zhang
Email: zhan4937@umn.edu
Office hours: (WDH 7-145): Monday 12:00 to 1:00pm, Friday 3:30 - 4:30pm.

Name: Surabhi Talele
Email: talel005@umn.edu
Office hours: Monday 3:30-5:30 pm (WDH 9-104); Tuesday 9:00 -11:00am (WDH 9-104); Friday 3:30-4:30 pm (WDH 7-145)

UMD
Name: Sravan Jonnalagadda
Email: skjonnal@d.umn.edu
Office hours (Chem 142): Tuesday: 2-4pm; Friday: 3:30-4:30pm.

Overview of the course

Course content:
In this course, a systematic approach establishes the fundamental physicochemical principles applicable to dosage forms. The foundational scientific principles (continued in DDII) are illuminated with key examples of solution drug dosage forms. These concepts are relevant to current as well as future dosage forms as drugs must be dissolved in a solution before they can be absorbed into the systemic circulation and eventually the site of action.

The fundamental physicochemical principles applicable to dosage forms discussed in this course will also be used in Drug Delivery II, Pharmacokinetics, Biopharmaceutics, and Pharmaceutical Compounding Lab. These principles include: intermolecular forces determining the state of matter, phase equilibria, ionic equilibria, colligative properties, solubility, partitioning, and pH-partition hypothesis, which are applied to solution dosage forms. These fundamentals will enable our students (as active learners) to readily adapt to new pharmaceutical knowledge and challenges during patient care.

Course format:
The course is made up of lectures and in-class workshops. Class meetings (lectures and in-class activities) will be on Tuesdays and Thursdays. Before each lecture, students will be provided with handout, reading assignment, and cases, which will introduce them to upcoming concepts, through Moodle course site. During the lectures, an instructor will explain concepts demonstrated with examples where possible. An in-class workshop on solving problems using the fundamental concepts taught during the lecture will be a part of each lecture. There will be online quizzes each week. Generally, the quizzes will open at noon on Friday, and close at noon in the following Monday. (See course schedule for details.)
At the beginning of the semester, students will be assigned a drug delivery **case study** involving the use of principles presented in this course; this assignment will be due at the end of the course. Students will be assigned to a small group (4-5 students) to work on this case study project, where two written reports are required. Each group member will receive the same score, and the students will evaluate their peers’ contribution/performance on this team project.

Students are required to attend all class meetings; view all online presentations; complete reading and homework assignments; successfully complete Prerequisite Proficiency Exam, quizzes, mid-term and final examinations, and contribute to case study reports.

**Prerequisites**

An online Prerequisite Proficiency Exam is required. Calculus (both differential and integral calculus), knowledge of the metric system, proficiency with logarithmic and exponential functions, understanding the use of equations and graphs, and comprehension of the fundamentals of organic chemistry are required for the successful completion of the Proficiency Exam. A passing score will be 70% and students may take the exam twice. Review/remediation material will be available online. **Students must successfully pass the Prerequisite Proficiency Exam with a grade of 70% or higher. Failure to pass the Prerequisite Proficiency Exam will result in the lowering of the final grade (for example receiving a C- rather than a C).**

- Other prerequisites: College of Pharmacy Student or permission of the Course Director.

**Computer/Technology Requirements**

The University of Minnesota computer requirements are listed here:

- [http://www1.umn.edu/moodle/start/technical.html](http://www1.umn.edu/moodle/start/technical.html)
- Calculator (model TI-30XA); Graphing calculators or smart phones are not allowed during exams.

**Course Goals & Objectives**

Main course concepts:

1. Solubility affects drug absorption and it can be modified by controlling solid state properties of drugs and solvent;
2. pH – solubility is a result of ionic equilibria of ionizable drugs. pH affects drug oral bioavailability (pH-partition hypothesis);
3. Isotonicity of solution dosage forms can be achieved by considering colligative properties of solutions

<table>
<thead>
<tr>
<th>LEARNING GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>After successfully completing this course, the student will be able to:</td>
</tr>
<tr>
<td>1. <strong>Explain</strong> the physicochemical principles underlying the preparation, properties, function and</td>
</tr>
<tr>
<td>performance of various common types of solution dosage forms. For example,</td>
</tr>
<tr>
<td>- <strong>explain</strong> the colligative properties of aqueous solution and their application to (impact on)</td>
</tr>
<tr>
<td>the isotonicity of solution dosage forms of a drug;</td>
</tr>
<tr>
<td>- <strong>explain</strong> the importance of solubility and partitioning in the formulation design and absorption</td>
</tr>
<tr>
<td>of drugs;</td>
</tr>
<tr>
<td>- <strong>recognize</strong> the linkage between the physicochemical characteristics of a dosage form and the</td>
</tr>
<tr>
<td>plasma concentration-time profile.</td>
</tr>
<tr>
<td>2. <strong>Choose</strong> the most appropriate type of solution dosage form for optimal drug delivery and</td>
</tr>
<tr>
<td>optimal drug therapy</td>
</tr>
</tbody>
</table>


according to patient-specific characteristics and select suitable inactive/inert ingredients based on their role and functions in solution.

- **Identify** and **articulate** the physicochemical and formulation properties of drug solutions that influence their delivery to the site of pharmacological action, such as viscosity, taste, and color.

3 **Perform** the various types of calculations related to the preparation of the common types of solution dosage forms. For example,

- **calculate** the amount of an ionizable drug in solution at biologically relevant pH, using the Henderson–Hasselbalch equation.

4 **Design** a protocol for the extemporaneous compounding of a solution dosage form.

- **Apply** knowledge of properties of drug solutions that influence dosage form design (e.g., stability) and the characteristics of an ideal drug delivery of liquid dosage forms.

5 **Engage** others in teamwork (other practitioners, patients, or caregivers) to **research** and **determine** the best patient care possible under different circumstances.

---

**Attendance Policy**

Students are expected to attend every class for which they are registered. Students are expected to attend classes on the campus where they are enrolled. Instructors may choose to take attendance. When a student is unable to attend a class for health or family reasons, the instructor must be informed in advance. Class attendance may be occasionally taken.

---

**Course Materials**

1. Course notes, written by each instructor, available to the students on the course website.


*Assigned readings are indicated in the course schedule.

---

**Assessments and Grading**

**Assignments and learning activities**

- The **case-study project** described below is a good platform for students to practice different course concepts and ideas within the broader context of patient care. Students usually start working on these team-based case study assignments from the very beginning of the course. This engages students with learning materials and fundamentals covered in the lectures within the context of pharmacy practice. Working in small groups to apply the basic knowledge learned in this course to patient care is critical for team-work, as well as communication skills in solving the problems.

- **Workshop** for hands-on problem-solving will engage students with the content, the instructor, and each other. Students are encouraged to consult instructor, TA, and classmate to solve problems as a means of active learning. The **problem sets** are developed in accordance with the content taught in the preceding lecture(s). For example, students may be asked to calculate solubility of a weak acid in water at different pHs and explain why it is important to patient care. Students will work on the problems first. They are encouraged to discuss the problems with each other while instructors and TAs will cruise the classroom offering help. Finally, the instructor will go over the problem with students. Workshops are required, but not graded.
Students also have opportunities to practice course concepts through working on **assigned homework problems**. Homework problems are required, but not graded.

**Graded Assessments**

1. **QUIZZES:** There will be 11 quizzes (worth 10 points each) scheduled throughout the semester. Quizzes consist of typically 9 – 10 multiple choices questions. Quizzes will be available online via the Moodle course site. A total of 30 min is allowed for taking each quiz. A student will be allowed to drop the lowest quiz grade, so he/she would have a maximum of 100 possible points from quizzes.

2. **EXAMS:** Two in-person midterm exams will each be worth 100 points (for a total of 200 points). A comprehensive in-person two-hour final exam will be given during the Final Exams Week. This is a required exam worth 100 points.

3. **SMALL GROUP CASE STUDY PROJECT:** Small groups of students are assigned case studies which are usually on compounding a solution dosage form to meet specific patients’ needs. Case studies are drawn from pharmacy practice, hence, providing authentic and contextual scenarios for assessing students’ learning. For example, students may be asked to compound 10 mL of 15% tobramycin sterile solution (used as eye drops post-surgery) that is not commercially available at this high strength. They may also be asked to compound a 3 mg/mL lansoprazole solution to fill a prescription for treating acid reflux in infants. To solve the problem, students need to correctly apply the concept of solubility, calculate the amount of drug, tonicity adjusting agent, and water needed. They also need to develop a compounding procedure, address the problem of stability, storage, and provide handling instructions to the patient. In some cases, sterility is also emphasized during the compounding procedure. Completion of two written reports (part I and II) on drug delivery case-study assignment is worth a maximum of 25 points (part I – 10 pts, part II – 15 pts). Each group member will receive the same score, and the students will evaluate their peers’ contribution/performance on this team project. Each student will receive 1 point for the peer evaluation except for students who do not turn in the evaluation form or who receive overwhelmingly negative peer evaluations.

4. **COURSE EVALUATION:** One point will be given for submitting an online course evaluation (a total of two course evaluations are available, the first one in the middle of the semester and the second one during the last week of the semester).

The following graded assessments will count toward your final grade for this course in the following amounts:

<table>
<thead>
<tr>
<th>#</th>
<th>Date/time</th>
<th>Title/Brief description</th>
<th>Assessment Goal</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>09/8 (noon) – 09/11 (noon)</td>
<td>Online Moodle Quiz 1</td>
<td>Describe why drugs need to be in solution before they can enter the systemic circulation. (Learning goal #1)</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>09/15 (noon) – 09/18 (noon)</td>
<td>Online Moodle Quiz 2</td>
<td>Describe the fundamental forces that define states of matter, and therefore physico-chemical properties. (Learning goal #1)</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>09/22 (noon) – 09/25 (noon)</td>
<td>Online Moodle Quiz 3</td>
<td>Describe physico-chemical properties of liquids and solids. (Learning goals #1 &amp; 2)</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>09/29 (noon) – 10/2 (noon)</td>
<td>Online Moodle Quiz 4</td>
<td>Articulate interconversion process among different phases of matter. (Learning goal #2)</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>10/6 (noon) – 10/9</td>
<td>Online Moodle Quiz 5</td>
<td>Calculate and convert solution</td>
<td>10</td>
</tr>
<tr>
<td>Week</td>
<td>Date(s)</td>
<td>Activity</td>
<td>Description</td>
<td>Weight</td>
</tr>
<tr>
<td>------</td>
<td>-----------------</td>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>6</td>
<td>10/16</td>
<td>In person Exam #1</td>
<td>Demonstrate proficiency in concepts #1 – #4 (Learning goals #1 &amp; 2)</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>10/20 (noon) – 10/23 (noon)</td>
<td>Online Moodle Quiz 6</td>
<td>Describe the concept and calculate neutral and ionized species in solution and dependence on pH (Learning goals #1, 3)</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>10/27 (noon) – 10/30 (noon)</td>
<td>Online Moodle Quiz 7</td>
<td>Apply key colligative properties and to solution dosage forms. (Learning goals #1, 2, 3, 4)</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>11/3 (noon) – 11/6 (noon)</td>
<td>Online Moodle Quiz 8</td>
<td>Define solubility as an equilibrium phenomenon; perform solubility calculations under different conditions. (Learning goals #1, 2, 3, 4)</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>11/10 (noon) – 11/13 (noon)</td>
<td>Online Moodle Quiz 9</td>
<td>Quantitatively describe the dependence of solubility on pH and effect of protein binding on drug delivery, and therefore efficacy. (Learning goals #1, 2, 3)</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>11/20</td>
<td>In-person Exam #2</td>
<td>Demonstrate proficiency in topics covered in #6 - #10 (Learning goals #1, 2, 3, 4)</td>
<td>100</td>
</tr>
<tr>
<td>12</td>
<td>11/24 (noon) – 11/27 (noon)</td>
<td>Online Moodle Quiz 10</td>
<td>Describe the intravascular administration of drugs in solution dosage forms, and related issues. (Learning goals #2, 3, 4)</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>12/01 (noon) – 12/4 (noon)</td>
<td>Online Moodle Quiz 11</td>
<td>Describe the extravascular administration of solutions dosage forms, and related issues. (Learning goals #2, 3, 4)</td>
<td>10</td>
</tr>
<tr>
<td>14</td>
<td>12/12 9:30pm – 11:30pm</td>
<td>In-person Final Exam</td>
<td>A comprehensive two-hour final exam will be given during the Final Exams Week. Demonstrate proficiency in all topics covered in this course (Learning goals #1, 2, 3, 4)</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>11/03 (noon)</td>
<td>Case Study Project Part I Report</td>
<td>Submit report of preliminary case work; identify the problems, issues; provide preliminary answers to case questions; Use real-world patient care scenarios to apply fundamental course concepts in solving drug delivery problems. Utilize teamwork and leadership skills</td>
<td>10</td>
</tr>
</tbody>
</table>
submit preliminary literature sources to support their work. (There is a rubric for this assignment.)

to analyze a case problem, and use course concepts to formulate a strategy to solve the problem.

Communicate to assign roles/tasks among the team members.

Search related literature. (Learning goals #1, 2, 3, 4)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>12/01 (noon)</td>
<td>Part II Report: Submit comprehensive report on case findings. (There is a rubric for this assignment.)  As above.</td>
</tr>
<tr>
<td></td>
<td>12/01 (noon)</td>
<td>Case Study Peer Review Students will evaluate their peers’ participation and contribution to the group project.  Group process and communicate with team members. (Learning goal #4)</td>
</tr>
<tr>
<td>TBD</td>
<td></td>
<td>Complete two online course evaluations (mid-term and final).</td>
</tr>
</tbody>
</table>

TOTAL POINTS 428

Unless approved by the course instructor ahead of time, no late work will be accepted.

Each student is bound by the following specific provisions of the Honor Code: Academic misconduct is any unauthorized act which may give a student an unfair advantage over other students, including but not limited to: falsification, plagiarism, misuse of test materials, receiving unauthorized assistance and giving unauthorized assistance. **Students are required to do their own work on all online and in-person exams and quizzes.**

**General Policies**
All required UMN and CoP policies, e.g., Academic Freedom; Attendance; Copyright; Course Evaluations; Disability Accommodations; Exams; FERPA; Grading; etc. apply in this course. They can be accessed at https://docs.google.com/a/umn.edu/document/d/1artQ5e1rbzxe8fEtWo7BE8k8snZAEgMMz_QcW8yJ-ll/edit

**Recording policy:** This course may be recorded and posted on a secure site to aid the students in learning the material. Lecture archives are not considered a replacement for attending lecture. **Students are expected to attend class.** Recorded lectures are supplemental to the live lectures and are available to help students in learning the material. Students are responsible for all material delivered in the live lecture regardless of successful recording and posting.

**Additional Exam Policy**

There will be no make-up quizzes given under any circumstances because students are allowed to drop a quiz.

**Grading Information**
A total of 428 points can be obtained on exams, quizzes and case study report as indicated above. A percentage will be calculated and grades will be assigned as follows:

**Course Letter Grades**
<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93.0 - 100</td>
</tr>
<tr>
<td>A-</td>
<td>90.0 – 93.0</td>
</tr>
<tr>
<td>B+</td>
<td>87.0 – 90.0</td>
</tr>
<tr>
<td>B</td>
<td>83.0 – 87.0</td>
</tr>
<tr>
<td>B-</td>
<td>80.0 – 83.0</td>
</tr>
<tr>
<td>C+</td>
<td>77.0 – 80.0</td>
</tr>
<tr>
<td>C</td>
<td>73.0 – 77.0</td>
</tr>
<tr>
<td>C-</td>
<td>70.0 – 73.0</td>
</tr>
<tr>
<td>D</td>
<td>60.0 – 70.0</td>
</tr>
<tr>
<td>F</td>
<td>0 – 60.0</td>
</tr>
</tbody>
</table>

**Re-grade Policy**
- Exam done with a pencil is not eligible for re-grading.
- Typed request for exam re-grading must be submitted to the course director within one week after receiving the exam back.

**Minimum Passing Level**
Please refer to the College of Pharmacy Academic Standing and Student Progression Policy and Procedures at [http://www.pharmacy.umn.edu/sites/pharmacy.umn.edu/files/academic_standing-and_student-progression.pdf](http://www.pharmacy.umn.edu/sites/pharmacy.umn.edu/files/academic_standing-and_student-progression.pdf)

**Detailed Course Outline & Schedule**

<table>
<thead>
<tr>
<th>Class (instructor)</th>
<th>Agenda/Topics</th>
<th>Competency / Learning Objective</th>
<th>Activities / Assignments / Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1 (Sun)</td>
<td>UNIT 1. INTRODUCTION TO DRUG DELIVERY</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Course introduction</td>
<td>Describe the outline of the course and its connection to other courses</td>
<td>NA</td>
</tr>
</tbody>
</table>
|                    | Introduction to drug delivery | Describe the need for dosage forms; Explain how the choice of dosage form is made; Explain functionality of key excipients in a formulation (Learning goals #2, 3, and 4) | In class activities
Interactive lectures
Workshop problems |
|                    | Concentration-time profile | Describe why drugs need to be in solution before they can enter the | In class activities
Interactive lectures |
| Week 2 (Sun & Johnson) | Introduction to ADME, Solution dosage forms, (including OTC solutions) | Describe the relationship between dose and AUC Identify factors that influence plasma drug concentration profile (Learning goals #1 & 2) | Workshop problems  
Assignments assigned reading | In-class Activities interactive lectures workshop problems  
Assignments assigned reading  
Assessment Quiz 1: Intro to Drug Delivery |
|---|---|---|---|---|
| Solution dosage forms | Explain common solution dosage forms (Learning goals # 1, 2, 3, 4) | In-class activities interactive lectures workshop problems  
Assignments assigned reading, practice problems, | UNIT 2. PROPERTIES OF DRUGS |
| Intermolecular forces | Identify the fundamental forces that define states of matter (Learning goal # 1) | In-class Activities interactive lectures workshop problems  
Assignments assigned reading case of the week workshop problems  
Assessment Quiz 2: Solution dosage forms & intermolecular forces |
| Week 3 (Johnson) | Properties of gases | Describe the key physicochemical properties of gases (Learning goal # 1) | In-class Activities interactive lectures workshop problems  
Assignments assigned reading practice problems, work on case study project |
| Properties of liquids | Describe the key physicochemical properties of liquids. (Learning goal # 1) | In-class Activities interactive lectures, workshop problems |
| Week 4 (Johnson) | Properties of solids | Describe the key physicochemical properties of solids.  
(Learning goal # 1) | In-class Activities  
interactive lectures  
workshop problems  
Assignments  
assigned reading  
practice problems,  
work on case study project  
Assessments  
Quiz 3: Gases and Liquids |
| --- | --- | --- | --- |
| Phase equilibrium solid/liquid  
liquid/vapor  
solid/vapor | Describe phase behavior from a phase diagram  
(Learning goal # 1) | In-class Activities  
interactive lectures  
workshop problems  
Assignments  
assigned reading,  
case of the week  
work on case study project  
Assessments  
Quiz 4: Solids and Phase equilibria |
| Week 5 (Johnson) | Gibbs phase rule  
lever rule  
eutectic melting  
solid dispersion | Apply phase rule to predict properties of multi-phase systems.  
(Learning goal # 1) | In-class Activities  
interactive lectures  
workshop problems  
Assignments  
assigned reading,  
practice problems,  
work on case study project |
| UNIT 3. PROPERTIES OF DRUGS IN SOLUTION | Solutions | Describe different types of solutions, applications in pharmacy | In-class Activities  
interactive lectures  
workshop problems  
Assignments  
assigned reading,  
practice problems,  
work on case study project  
Assessments |
<table>
<thead>
<tr>
<th>Week 6 (Johnson &amp; Sun)</th>
<th>Expressions of concentration/inter-conversion</th>
<th>Calculate solution concentration; (Learning goals # 1, 3)</th>
<th>Quiz 5: Phase Equilibria, solution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ionic equilibria (acids and bases)</td>
<td>Define the concepts of acid and base, pKa</td>
<td>In-class Activities interactive lectures workshop problems</td>
</tr>
<tr>
<td></td>
<td>Acidity constant (pKa)</td>
<td>(Learning goals # 1, 2, 3)</td>
<td>Assignments assigned reading, practice problems, case of the week work on case study project</td>
</tr>
<tr>
<td></td>
<td>Conjugated acid of a base</td>
<td></td>
<td>Assignments assigned reading, practice problems, work on case study project</td>
</tr>
</tbody>
</table>

### Week 7 (Sun)

<table>
<thead>
<tr>
<th>Exam 1: Oct. 16, 2017 (Monday), 3:30-5:30pm in Moos 1-450/163 LSci</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ionization of acid as a function of pH</td>
</tr>
<tr>
<td>Ionization of base as a function of pH</td>
</tr>
<tr>
<td>pH buffering</td>
</tr>
<tr>
<td>Calculate % ionized species of an acid in solution based on pH and pKa</td>
</tr>
<tr>
<td>Calculate % ionized species of a base in solution based on pH and pKa</td>
</tr>
<tr>
<td>Calculate pH of a buffer (Learning goals # 1, 2, 3)</td>
</tr>
<tr>
<td>Assignments assigned reading, practice problems, work on case study project</td>
</tr>
<tr>
<td>Assessments Quiz 6: Concentration and Ionic equilibria</td>
</tr>
</tbody>
</table>

**Fall break (10/19 – 10/20)**

<table>
<thead>
<tr>
<th>Week 8 (Sun)</th>
<th>Biopharmaceutic al Classification System ideal &amp; regular solutions general solubility equation</th>
<th>Articulate importance of solubility of drugs in drug delivery; Describe the differences between an ideal solution and a regular solution (Learning goals # 1, 2, 3, 4)</th>
<th>In-class Activities interactive lectures workshop problems, case of the week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>solubility phase diagram, solubility products of salts</td>
<td>Calculate solubility from phase diagram (liquid – liquid, solid-liquid)</td>
<td>Assignments assigned reading, practice problems, work on case study project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calculate solubility of a drug from its solubility product (Learning goals # 1, 2, 3, 4)</td>
<td>In-class Activities interactive lectures workshop problems,</td>
</tr>
</tbody>
</table>
| Week 9 (Sun) | pH solubility | Describe pH dependence of solubility.  
(Learning goals # 1, 2, 3, 4) | In-class activities  
interactive lectures  
workshop problems  
case of the week  
Assignments  
assigned reading,  
practice problems,  
work on case study project  
Assessments  
Quiz 7: Solubility |
|---|---|---|---|
| **Effects of temperature, crystal size, cosolvent, and solid form on drug solubility,** | List factors that affect solubility and explain why | In-class activities  
interactive lectures  
workshop problems  
case of the week  
Assignments  
assigned reading,  
practice problems,  
work on case study project |
| **Solubility measurement and enhancement** | Propose solubilization strategies,  
(Learning goals # 1, 2, 3, 4) | In-class activities  
interactive lectures  
workshop problems  
case of the week  
Assignments  
assigned reading,  
practice problems,  
work on case study project |
| **Week 10 (Wiedmann)** | Colligative properties | Explain importance of colligative properties to solution dosage forms.  
Calculate vapor pressure, boiling point, melting point, and osmotic pressure of a solution  
(Learning goals # 1, 2, 3) | In-class Activities  
interactive lectures  
workshop problems,  
case of the week  
Assignments  
assigned reading,  
practice problems,  
work on case study project |
<table>
<thead>
<tr>
<th>isotonicity isotonicity adjustment E-value</th>
<th>Define isotonicity for solutions Calculate tonicity of a solution and amount of an tonicity adjusting agent for achieving isotonicity (Learning goals # 1, 2, 3)</th>
<th>In-class Activities interactive lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 11 (Wiedmann)</strong></td>
<td>Binding to proteins Explain effects of protein binding on effectiveness of drugs (Learning goals # 1, 3)</td>
<td>In-class activities interactive lectures workshop problems</td>
</tr>
<tr>
<td></td>
<td>Partitioning Explain partitioning behavior of a drug in aqueous and oil phase; Articulate the relevance of partitioning to drug delivery; (Learning goals # 1, 2, 3, 4)</td>
<td>In-class activities interactive lectures workshop problems</td>
</tr>
<tr>
<td></td>
<td><strong>Exam 2: Nov. 20, 2017 (Monday), 3:30-5:30pm in Moos 5-125/165 LSci</strong></td>
<td><strong>UNIT 4. When must drug molecules be in solution?</strong></td>
</tr>
<tr>
<td></td>
<td>Intravascular administration a. mass transport by flow b. protein binding Describe key issues related to intravascular administration of drug solutions. (Learning goals # 1, 2, 3, 4)</td>
<td>In-class activities interactive lectures workshop problems case of the week</td>
</tr>
<tr>
<td></td>
<td><strong>Thanksgiving (11/23-11/24)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Week 13 (Wiedmann)</strong> c. Parenteral dosage forms (sterility) List common parenteral dosage forms, their preparation, usage and key issues</td>
<td>In-class activities interactive lectures workshop problems</td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
<td>Learning goals</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Extravascular routes of administration</td>
<td>Explain why partitioning is critical for distribution of drugs administered extravascularly (Learning goals # 1, 2, 3, 4)</td>
<td>Describe key issues related to administration of drug solutions extravascularly (drug must cross membranes). (Learning goals # 1, 2, 3, 4)</td>
</tr>
<tr>
<td><strong>Week 14 (Wiedmann)</strong></td>
<td>mass transfer by diffusion</td>
<td>Define diffusion and describe relevant examples in the practice of pharmacy Define Fick’s laws of diffusion and their application Calculate diffusion coefficient, lag time Describe the various driving forces for diffusion (Learning goals # 1, 2, 3, 4)</td>
</tr>
<tr>
<td><strong>Week 14 (Wiedmann)</strong></td>
<td>pH-partition hypothesis in drug absorption</td>
<td>Predict rate and extent of absorption of a drug based on pH (Learning goals # 1, 2, 3, 4)</td>
</tr>
</tbody>
</table>

* Subject to change at course instructor’s discretion.

**Classroom Etiquette**

1. Students are expected to be respectful to the professors, teaching assistants, and your fellow students.

2. Students are expected not to be disruptive during class time, which is annoying and impolite to your fellow students and to the instructors. Disruptive behavior includes the following:
a Arriving late for class
b Reading your newspaper, doing crossword puzzles (or Sudoku!), studying for exams, texting, sending and receiving IM's, shopping online, etc.
c Habitually leaving class early.
d Conducting side conversations while the instructor is lecturing.
e Having your cell phone ring
f Snoring

3 Student announcements may be made before class officially starts, after it officially ends, or during class breaks.