Drug Chemistry and Toxicology (FRNSC 532)

Fall 2018, Millennium Science Complex N205

Class Dates/Time: Mondays, Wednesdays, & Fridays from 9:05 am to 9:55 am

Office Hours: Mondays, 2:00 pm – 4:00 pm, or by appointment

COURSE DESCRIPTION

Instructor

Mr. Stewart Hung, Assistant Teaching Professor

329B Whitmore Laboratory

sxh611@psu.edu Office Number: (814) 863-3387

Introduction

This graduate level course covers the fundamental aspects of drug chemistry with an emphasis on forensically relevant compounds, the metabolism of these drugs, as well as the analytical methods that are used in testing laboratories. The material requires a strong foundation in organic chemistry and some basic physiology. Pharmacological aspects of the drug substances are discussed in relation to criminal and civil investigations, interpretation of laboratory results, and drug mixtures.

The overall objectives of the course are to attain an advanced understanding of drugs and their metabolites so that the student can identify, sample, extract, analyze, and interpret the results in the proper context.

The structure of the course will be a combination of lectures, case studies, class discussions, and student presentations. Throughout the semester, the course will build upon material already introduced so that the student will have a much more complete understanding of drug chemistry and forensic toxicology. The final project will be a comprehensive presentation near the end of the semester.

Reading Materials and Textbook

- **Principles of Forensic Toxicology, Fourth Edition. Barry Levine. ISBN 978-1-59425-158-0**
- **Journal articles for Case Studies and Class Presentations**
- **(potentially) Course Reserve materials**
- **Resources posted on Box (Primary) and Canvas**

GRADING AND LETTER GRADE ASSIGNMENTS

The grading assignments for this course are:

Grade	Percentile (%)
A	100 to 94
A-	< 94 to 90
B+	< 90 to 87
B	< 87 to 84
B-	< 84 to 80
C+	< 80 to 77
C	< 77 to 70
D	< 70 to 60
F	< 60 to 0

Written assignments: There are twelve (12) written assignments during this semester which examine

the students' understanding of the course material. The writing assignments are either long scientific/technical writing or short answers for assignments.

Presentation: The students will have an assigned topic and present important aspects of the drug/toxicology topic which may include the chemistry, pharmacokinetics, metabolism, routes of entry, sample preparation, analytical methods, and other important considerations in the analysis and interpretation of the results.

Examinations: There are four (4) quizzes and a final examination for this course.

Optional assignment:

There are no optional assignments at this time. Extra credit assignments may be introduced during the semester which may total up to an additional 5% of the grade.

Course Changes:

The course calendar can be changed at any time, and the student will be responsible for abiding by all changes. Changes will be posted on Canvas and/or announced in class.

COURSE CALENDAR (*SUBJECT TO REVISION*)

The Course Calendar is appended to this syllabus and is subject to revision.

ATTENDANCE POLICY

Attendance will be monitored. Although the Faculty Senate Policy 42-27 applies directly to undergraduates, in FRNSC 532, the graduate students are responsible for attending classes and the work that is covered. At the discretion of the instructor, the student's grade may be lowered because of significant class absences.

Regular attendance is expected of all students for this course. If an absence is anticipated (e.g., interviews, conferences, presentations, research constraints, etc.), please let the instructor know as early as possible. Students are responsible for all the material that was covered in all classes, including the ones that the student could not attend.

Timeliness. Please be on time for each class. Tardiness can be disruptive to any discussion or lecture that is already in progress.

Absences. Whenever possible, students should inform instructors prior to missing classes for reasons beyond their control (e.g., illness, injury, family emergency). If an evaluative event (e.g., a quiz or exam) will be missed due to an unavoidable illness or emergency, it is the student's responsibility to contact the instructor as soon as the unavoidable absence is known to discuss ways to make up the work.

Making up Missed Work. If an absence occurs on a Case Studies class, then that work cannot be made up. If you anticipate missing a Quiz or need to re-schedule your Class Presentation, please inform the instructor at least one week in advance so that alternate arrangements could be made. Any missed work or assignments are the student's responsibility.

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UNIVERSITY POLICIES

Academic Integrity

Please be familiar with Penn State's policies on academic integrity (Faculty Senate Policy 49-20).

Definition and expectations: Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

Link: http://science.psu.edu/current-students/Integrity/Policy.html

In FRNSC 532, academic dishonesty will not be tolerated. Plagiarism, representation of someone else's work as your own, cheating on quizzes/exams, and other unethical actions may result in a grade of zero for that project, presentation, quiz, etc. Repeated unethical actions may result in an Academic or Disciplinary Sanction.

Code of Mutual Respect

The Eberly College of Science is a community dedicated to personal and academic excellence. The Code of Mutual Respect and Cooperation was developed to embody the values that we hope our faculty, staff, and students possess, consistent with the aspirational goals expressed in the Penn State Principles. The University is strongly committed to freedom of expression, and consequently, the Code does not constitute University or College policy, and is not intended to interfere in any way with an individual's academic or personal freedoms. We hope, however, that individuals will voluntarily endorse the 12 principles set forth in the Code, thereby helping us make The Eberly College of Science a place where every individual feels respected and valued, as well as challenged and rewarded.

The 12 Principles of the Code are:

1. Treat everyone equally and with respect
2. Be courteous
3. Be ready to communicate
4. Encourage others and share your expertise with them
5. Give and accept constructive criticism
6. Be receptive to change
7. Be a team player
8. Get involved
9. Have a positive attitude
10. Be honest and accept responsibility
11. Recognize other people's priorities
12. Strive to do your best

Link: http://science.psu.edu/climate/code-of-mutual-respect-and-cooperation

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Student Disability Resources (SDR)

Student Disability Resources (SDR) is the designated office that provides reasonable accommodations and services to students with disabilities who are enrolled at the University Park location. In addition, Penn State has a disability services office at every Penn State campus that provides accommodations and services for students with disabilities. Each designated office requests and maintains disability-related documents; certifies eligibility for services; determines and develops plans for reasonable accommodations such as academic adjustments, auxiliary aids, and/or services as mandated under Title II of the Americans with Disabilities Act, Amendments Act (ADAAA) of 2008 and Section 504 of the Rehabilitation Act of 1973.
A list of the disability services contacts at every Penn State campus can be found at this link: Disability Service Coordinators at other Penn State Campuses

Student Disability Resources
The Pennsylvania State University
116 Boucke Building
University Park, PA 16802
Phone: 814 863-1807
Fax: 814 863-3217

NONDISCRIMINATION STATEMENT

The Pennsylvania State University is committed to equal access to programs, facilities, admission and employment for all persons. It is the policy of the University to maintain an environment free of harassment and free of discrimination against any person because of age, race, color, ancestry, national origin, religion, creed, service in the uniformed services (as defined in state and federal law), veteran status, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas. Discriminatory conduct and harassment, as well as sexual misconduct and relationship violence, violates the dignity of individuals, impedes the realization of the University's educational mission, and will not be tolerated.

Direct all inquiries regarding the nondiscrimination policy to:

Affirmative Action Office
The Pennsylvania State University
328 Boucke Building
University Park, PA 16802-5901
Email: aao@psu.edu
Tel: (814) 863-0471

DIVERSITY STATEMENT

I consider this classroom to be a place where you will be treated with respect. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Penn State is "committed to creating an educational environment which is free from intolerance directed toward individuals or groups and strives to create and maintain an environment that fosters respect for others" as stated in Policy AD29 Statement on Intolerance.

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MANDATED REPORTING STATEMENT

Penn State's policies require me, as a faculty member, to share information about incidents of sex-based discrimination and harassment (discrimination, harassment, sexual harassment, sexual misconduct, dating violence, domestic violence, stalking, and retaliation) with Penn State's Title IX coordinator or deputy coordinators, regardless of whether the incidents are stated to me in person or shared by students as part of their coursework. For more information regarding the University's policies and procedures for responding to reports of sexual or gender-based harassment or misconduct, please visit http://titleix.psu.edu.

Additionally, I am required to make a report on any reasonable suspicion of child abuse in accordance with the Pennsylvania Child Protective Services Law.

SAFE ZONE STATEMENT

I am a member of the Penn State Safe Zone Ally Network, and I am available to listen and support you in a safe and private manner. As a Safe Zone Ally, I can help you connect with resources on campus to address problems you may face that interfere with your academic and social success on campus as it relates to issues surrounding sexual orientation and gender identity. My goal is to help you be successful and to maintain a safe and equitable campus. For more information visit the Penn State LGBTQA Student Resource Center in 101 Boucke Building or at: studentaffairs.psu.edu/lgbtqa

LEARNING OUTCOMES

- To be aware of the factors that make it difficult to detect performance enhancing drugs; namely, differentiation between endogenous and exogenous sources, baseline levels of metabolites, and cofounding factors
- To understand the role of the DRE and the legal concerns that are raised over its acceptance as scientific testimony
- To understand the drug chemistry of these classes of drugs, the analytical methods that are employed, and their pharmacology (in week 4)
- To be knowledgeable of the extraction and conversion of cocaine from a chemist's perspective
- To be aware of the clandestine laboratory operation of a methamphetamine laboratory
- To understand the role of each of the components of a spectrophotometer
- To be able to select the appropriate method of analysis
- To understand the operation of a chromatographic MS system as applied to a specific drug sample
- To be able to describe the ADME model using cocaine as an example
- To describe the GPCR signaling process using adrenaline as an example
- To understand the drug chemistry of these classes of drugs, the analytical methods that are employed, and their pharmacology
- To understand why opiates are the most abused drug

- To describe and understand how all the components of an ELISA assay functions
- To use ELISA as a basis for understanding method development
- To describe and understand how all the components of an ELISA assay functions
- To use ELISA as a basis for understanding method development
- To understand the roles of Phase I and Phase II metabolic pathways
- To be aware of the differences in drug scheduling under the Controlled Substances Act of 1970
- To understand the role of quality assurance for drug and toxicological laboratory testing
- To be aware of the different types of cannabis products and their manufacture
- To understand the laboratory analysis in the identification of synthetic cannabinoids
- To understand the chemistry of breathalyzer reaction and its limitations
- To understand the laboratory testing procedure for blood alcohol concentrations
- To be aware of the legal statutes and concentration levels for DUIs

REFERENCES

(1) **Goodman & Gilman's The Pharmacological Basis of Therapeutics. (12th Edition)** Goodman, Louis S; Gilman, Alfred, 1908-1984; Brunton, Laurence L; Blumenthal, Donald K; Murri, Nelda; Hilal-Dandan, Randa, McGraw-Hill, New York, 2011. Available online at PSU Library.

(2) **Principles of Clinical Pharmacology (Third Edition)**, Academic Press, 2012. Chapters 1, 2, 3, and 4. Available online at PSU Library.

(3) **Forensic Science Handbook, Volume III**, Saferstein, Richard, Editor. Prentice Hall, 2010. Chapters 5 and 6.

(4) **Fundamentals of Analytical Chemistry.** (7th Edition) Skoog, Douglas A, West, Donald M, Holler, F.James. 1996.

(5) **Casarett and Doull's Toxicology:** The Basic Science of Poisons. (8th Edition) Klaasen, Curtis. McGraw Hill, New York, 2013. Available online at PSU Library.

(6) OpenStax, *Chemistry*, OpenStax. 11 March 2015. http://cnx.org/content/col11760/latest/

(7) Open Textbook Library. General Chemistry: Principles, Patterns, and Applications, 2011. http://www.oercommons.org/courses/general-chemistry-principles-patterns-and-applications/view

Additional resources will be posted on Canvas and Dropbox during the semester.

FRNSC 532 Fall 2018 – LEC Course Calendar (NOTE: Subject to Revision)

Week	Date	Details / Description / Readings
0	-	
1	M Aug 20	Introduction, Syllabus, Expectations, Assignments
	W Aug 22	Learning about Plagiarism
	F Aug 24	Case Study #1 – Performance Enhancing Drugs
2	M Aug 27	(LEC) Important Chemistry Concepts for FRNSC 532
	W Aug 29	(LEC) Important Biochemistry Concepts for FRNSC 532
	F Aug 31	Case Study #1 – Performance Enhancing Drugs
3	**M Sep 03**	**NO CLASS – Labor Day**
	W Sep 05	(LEC) Concepts – Calibration Curves
	F Sep 07	(LEC) Calibration Curves – in-class exercise
4	**M Sep 10**	**Guest Speaker – Mr. Brian Pirot**
	W Sep 12	(LEC) Drug Testing – DRE, Roadside Testing
	F Sep 14	Case Study #2
5	**M Sep 17**	**QUIZ #1**
	W Sep 19	(LEC) Drug Class – Stimulants – Cocaine
	F Sep 21	Case Study #3
6	M Sep 24	(LEC) Drug Class – Stimulants – Amphetamines
	W Sep 26	(LEC) Drug Class – Narcotics – Opiates
	F Sep 28	Case Study #4
7	M Oct 01	(LEC) Instrumental Methods for Drug Chemistry
	W Oct 03	(LEC) Chromatography for Drug Chemistry and Toxicology Part 1
	F Oct 05	Case Study #5
8	**M Oct 08**	**Guest Speaker – Mr. Andrew Bowen**
	W Oct 10	(LEC) Chromatography for Drug Chemistry and Toxicology Part 2
	F Oct 12	Case Study – Group A

FRNSC 532 Fall 2018 – LEC Course Calendar (NOTE: Subject to Revision)

Week	Date	Details / Description / Readings
9	M Oct 15	(LEC) Spectroscopic Methods for Drug Chemistry
	W Oct 17	(LEC) Color and Microcrystalline Tests for Drug Chemistry
	F Oct 19	Case Study – Group B
10	**M Oct 22**	**QUIZ #2**
	W Oct 24	**NO CLASS – NEAFS**
	F Oct 26	**NO CLASS – NEAFS**
11	M Oct 29	(LEC) Pharmacology – Pharmacokinetics
	W Oct 31	(LEC) Pharmacology – Pharmacodynamics
	F Nov 02	Case Study – Group C
12	M Nov 05	(LEC) Drug Scheduling and Classification
	W Nov 07	(LEC) Method Development
	F Nov 09	Case Study – Group D
13	**M Nov 12**	**QUIZ #3**
	W Nov 14	(LEC) Quality Assurance and Quality Control
	F Nov 16	TBD
14	**M Nov 19**	**NO CLASSES – Thanksgiving Break**
	W Nov 21	**NO CLASSES – Thanksgiving Break**
	F Nov 23	**NO CLASSES – Thanksgiving Break**
15	M Nov 26	(LEC) Methods in Forensic Toxicology – Immunoassays
	W Nov 29	(LEC) Methods in Forensic Toxicology – Chromatographic, etc.
	F Nov 30	Case Study – Group E
16	**M Dec 03**	**QUIZ #4**
	W Dec 05	TBD
	F Dec 07	TBD
Exam	-	Final Examination Date/Time TBD