

UNIVERSITY OF FLORIDA
COLLEGE OF MEDICINE SYLLABUS
NEUROSCIENCE
Molecular Neuroscience and Neuropharmacology
(3 credit hours)
GMS6023
Spring 2025
Delivery Format: In person
MBI, L1-101
Fridays 9:00am-12:00pm.
Start Date
End date
No class on Friday, February 7th

Instructors: Dr. Habibeh Khoshbouei and Dr. Eduardo Candelario-Jalil

Room Number: MBI, L1-101

Phone Number: 352-273-8115 (Dr. Khoshbouei) and 352-273-7116 (Dr. Candelario-Jalil)

Email Addresses: habibeh@ufl.edu and ecandelario@ufl.edu

Office Hours: Mondays 1-3pm and Wednesdays 9-11am (Office: L2-116)

Graduate Assistant: None

Preferred Course Communications: Email

Prerequisites:

Doctoral students. You are expected to be familiar with basic Neuroscience concepts before starting this course series. If you are uncertain about the sufficiency of your background, you are encouraged to read through chapters one through ten in Neuroscience Online – an electronic textbook (Open Access)

<https://nba.uth.tmc.edu/neuroscience/>

Purpose and Outcome

This is one of the required courses for the Neuroscience concentration. It is intended for all PhD students interested in learning about the neurochemical basis for drug action.

Course Overview

This course surveys the basic principles of neuropharmacology with an emphasis on the molecular pharmacology of drugs used to treat CNS disorders. The specific focus of this course will be to provide a description of the cellular and molecular actions of drugs on synaptic transmission with in-depth discussion of drug-induced changes in functioning of the nervous system. We will examine how the neurotransmitter systems influence nervous system function as well as therapeutic targets affecting these neurotransmitter systems. Issues surrounding drug

entry into the central nervous system will be addressed. Clinical applications of neuropharmacology, the link between neuropharmacology and behavior, and current research investigating the development of drugs for neuronal targets will be addressed. This course is designed to provide a foundation for advanced knowledge in behavioral neuroscience and neuropsychopharmacology, and to provide an introduction to the pharmacological treatment of CNS pathologies. The ultimate goal is to understand how molecular neuroscience can guide the direction of basic medical science and therapeutic approaches.

Course Objectives and/or Goals:

Upon successful completion of this course, students will obtain basic knowledge of the neurochemical mechanisms underlying the action of drugs acting on the central nervous system. We will focus on the effects of drugs on synaptic transmission at the cellular and molecular levels. Students will gain an appreciation and new knowledge of drug-induced changes in CNS function in health and disease. Students will have the opportunity to explore several brain disorders associated with alterations in the function of specific neurotransmitter systems and gain a basic understanding of current and future neuropharmacological treatments for these neurological diseases.

Instructional Methods:

Course materials will be delivered using traditional lectures and online platforms. Student projects will be created and delivered using VoiceThread, an asynchronous communication learning platform.

Student projects: Learning projects will provide opportunities to review course material and explore topics of interest in more depth. Students will select a recent paper related to one of the lectures and write an essay of ~1,000 words that would include a summary of the main findings of the study, significance of the results, and a critical evaluation of the data based on a literature review of other published work.

Blended Learning:

What is blended learning and why is it important?

A Blended Learning class uses a mixture of technology and face-to-face instruction to help you maximize your learning. Knowledge content that, as the instructor, I would have traditionally presented during a live class lecture is instead provided online before the live class takes place. This lets me focus my face-to-face teaching on course activities designed to help you strengthen higher order thinking skills such as critical thinking, problem solving, and collaboration. Competency in these skills is critical for today's health professional.

What is expected of you?

You are expected to actively engage in the course throughout the semester. You must come to class prepared by completing all out-of-class assignments. This preparation gives you the knowledge or practice needed to engage in higher levels of learning during the live class sessions. If you are not prepared for the face-to-face sessions, you may struggle to keep pace with the activities occurring in the live sessions, and it is unlikely that you will reach the higher learning goals of the course. Similarly, you are expected to actively participate in the live class. Your participation fosters a rich course experience for you and your peers that facilitates overall mastery of the course objectives.

Description of Course Content:

Topical Outline/Course Schedule

This course will take place every Friday from 9:00 a.m.-12:00 pm during the Spring semester. In the table below, we have provided the specific dates for each class.

No class on Friday, February 7th

| Week | Date(s) | Topic(s) | Lecturer | Readings |
|------------------------------------|----------------|---|----------------------|---|
| 1 Location: MBI, L1-101 | January 17 | Introduction to Neuropharmacology. History of Drug Discovery Past to Present Theoretical and practical analysis of Receptor Occupancy (Part I). | Khoshbouei | Chapter 1. <i>Molecular Neuropharmacology</i> (Nestler et al). |
| 2 Location: MBI, L1-101 | January 24 | Theoretical and practical analysis of Receptor Occupancy (Part II). Cellular and Molecular Identity of the Cells of the Central Nervous System (CNS). Neurons and circuits. Cellular Responses to drug action. | Khoshbouei | Chapter 1, 2 and 3. <i>Molecular Neuropharmacology</i> (Nestler et al). |
| 3: Location: MBI, L1-101 | January 31 | Principles of Nervous System Physiology & Pharmacology Sites of Drug Action & Signal Transduction Mechanisms Pharmacogenomics | Candelario- Jalil | Chapters 4, 7 and 9. <i>Principles of Pharmacology</i> (Golan et al) |
| No Class - February 7 (SfN) | | | | |
| 4 MBI, L1-101 | February 14 | Glutamatergic Neurotransmission – NMDA, AMPA, Kainate, and Metabotropic Receptors | Candelario- Jalil | Chapter 17. <i>Basic Neurochemistry</i> (Brady et al). Chapter 13. <i>Principles of Pharmacology</i> (Golan et al) |

| | | | | |
|---|----------------|---|------------------|---|
| | | Pathophysiology & Pharmacology of Glutamatergic Neurotransmission | | |
| 5 MBI, L1-101 | February 21 | Neurophysiology of the Dopaminergic System and its Pathology. Dopaminergic Receptor System. Parkinson's Disease | Khoshbouei | Chapter 14. <i>Principles of Pharmacology</i> (Golan et al) Chapter 14. <i>Basic Neurochemistry</i> (Brady et al). |
| 6 MBI, L1-101 | February 28 | GABA & Glycine Neurotransmission Pathophysiology & Pharmacology of GABAergic & glycinergic Neurotransmission | Candelario-Jalil | Chapter 13. <i>Principles of Pharmacology</i> (Golan et al) Chapter 18. <i>Basic Neurochemistry</i> (Brady et al). |
| 7 MBI, L1-101 | March 7 | Neuropharmacology of Acetylcholine- General Aspects Drugs acting on Muscarinic Receptors Neurophysiology of Nicotinic Acetylcholine Receptor System Nicotinic Acetylcholine Receptor System (Neuropharmacology) | Candelario-Jalil | Chapter 13. <i>Basic Neurochemistry</i> (Brady et al). Chapter 10. <i>Principles of Pharmacology</i> (Golan et al) |
| 8 MBI, L1-101 | March 14 | Basic Principles of Neuroendocrine Control. Oxytocin, vasopressin, hormones of the anterior pituitary gland, Leptin, melanocortin. Other mediators acting on the CNS: Histamine, Melatonin, Eicosanoids, Nitric oxide, Purines. | Candelario-Jalil | Chapters 27, 43, and 44. <i>Principles of Pharmacology</i> (Golan et al) Chapter 16 and 20. <i>Basic Neurochemistry</i> (Brady et al). |
| MBI, L1-101 | | Midterm Exam | | |
| Spring Break – March 15th through March 22nd | | | | |
| 9 MBI, L1-101 | March 28 | Neurophysiology of anesthesia Anesthetics – Neuropharmacology | Martynyuk | Chapter 17. <i>Principles of Pharmacology</i> (Golan et al) |
| 10 MBI, L1-101 | April 4 | Dopaminergic Receptor System (Neuropsychiatric disorders, Addiction, Bipolar disorder, Schz). Therapeutic Approaches (Neuropharmacology) | Khoshbouei | Chapter 14. <i>Principles of Pharmacology</i> (Golan et al) Chapter 14. <i>Basic Neurochemistry</i> (Brady et al). |

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|---|----------|--|------------|---|
| 11 MBI, L1-101 | April 11 | Neurophysiology & Pathology of the Adrenergic System Adrenergic System Neuropharmacology | Khoshbouei | Chapter 15. <i>Principles of Pharmacology</i> (Golan et al) Chapter 14. <i>Basic Neurochemistry</i> (Brady et al). |
| 12 MBI, L1-101 | April 18 | Serotonergic Receptor System. Therapeutic Approaches (Neuropharmacology) | Khoshbouei | Chapter 15. <i>Principles of Pharmacology</i> (Golan et al) Chapter 15. <i>Basic Neurochemistry</i> (Brady et al). |
| Reading Days – April 24th through April 25th | | | | |
| 13 MBI, L1-101 | | Student's project presentation Adrenergic lecture | Khoshbouei | Chapter 20. <i>Basic Neurochemistry</i> (Brady et al). Chapter 19. <i>Principles of Pharmacology</i> (Golan et al) |
| 14 MBI, L1-101 | | Remaining lectures (adrenergic/serotonergic) | Khoshbouei | |
| MBI, L1-101 | May 2 | Final Comprehensive Exam | | |

Disclaimer: This syllabus represents our current plans and objectives. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.

Course Materials and Technology:

One of the following Textbooks is recommended for this course:

- *Basic Neurochemistry: Principles of Molecular, Cellular, and Medical Neurobiology*
Scott T. Brady, George J. Siegel, R. Wayne Albers, Donald L. Price -- 8th Ed. Oxford, UK:
Academic Press, 2012.
ISBN: 978-0-12-374947-5
- *Molecular Neuropharmacology: A Foundation for Clinical Neuroscience*
Eric Nestler, Paul J. Kenny, Scott J. Russo, Anne Schaeffer -- 4th Ed., New York, NY:
McGraw-Hill, 2020.
ISBN: 978-1-260-45690-5
- *Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy.*

David E. Golan, Ehrin J. Armstrong, April W. Armstrong. – 4th Ed. Philadelphia: Wolters Kluwer, 2017.

ISBN: 978-1451191004

Reference books available at the library (on hold)

- *Cell Surface Receptors: A Short Course on Theory and Methods*
Lee E. Limbird, 3rd ed. Springer; 3rd edition. 2004. ISBN-13: 978-038723069
- *Psychopharmacology: Drugs, the Brain and Behavior*
Meyer, Jerrold S., and Linda F. Quenzer. 1st ed. Sunderland, MA: Sinauer Associates, 2004. ISBN: 9780878935345.
- *The Pharmacological Basis of Therapeutics.* Laurence Brunton. Goodman & Gilman's 12th ed. McGraw-Hill Professional; 2011. ISBN: 978-0071354691
- *The Biochemical Basis of Neuropharmacology.*
Cooper R. Jack, Floyd E. Bloom, Robert H. Roth -- 8th ed. Oxford, USA: Oxford University Press, 2002. ISBN: 9780195140088
- *Principles of Neural Science. Kandel*
Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, Steven A. Siegelbaum, A.J. Hudspeth -- 5th ed. McGraw-Hill Publishers. 2013. ISBN: 978-0071390118.

For technical support for this class, please contact the UF Help Desk at:

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- [UF eLearning](#)

Academic Requirements and Grading:

There are two exams in this course, a mid-term and a final comprehensive exam. There will be in-class quizzes comprised primarily of multiple choice and short answer questions.

Assignments:

If assigned individual projects must be completed and posted or turned in by the due date/time to obtain credit for the work.

Grading:

The grade will be assigned based on numerical performance on two examinations, one mid-term, and a final comprehensive exam at the end of the course. Students will be expected to answer all

of the questions on each exam. Student projects and in-class quizzes will also be considered in the final grading.

In-class quizzes: 20%

Midterm Exam: 40%

Final **Comprehensive** Exam: 40%

Point system used (i.e., how do course points translate into letter grades).

Example:

| Percentage Earned | Letter Grade |
|-------------------|--------------|
| 93-100 | A |
| 90-92 | A- |
| 87-89 | B+ |
| 83-86 | B |
| 80-82 | B- |
| 77-79 | C+ |
| 73-76 | C |
| 70-72 | C- |
| 67-69 | D+ |
| 63-66 | D |
| 60-62 | D- |
| Below 60 | E |

Please be aware that a C- is not an acceptable grade for graduate students. The GPA for graduate students must be 3.0 based on 5000 level courses and above to graduate. A grade of C counts toward a graduate degree only if based on credits in courses numbered 5000 or higher that have been earned with a B+ or higher.

| Letter Grade | Grade Points |
|--------------|--------------|
| A | 4.0 |

| | |
|-----|------|
| A- | 3.67 |
| B+ | 3.33 |
| B | 3.0 |
| B- | 2.67 |
| C+ | 2.33 |
| C | 2.0 |
| C- | 1.67 |
| D+ | 1.33 |
| D | 1.0 |
| D- | 0.67 |
| E | 0.0 |
| WF | 0.0 |
| I | 0.0 |
| NG | 0.0 |
| S-U | 0.0 |

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Exam Policy:

Policy Related to Make up Exams or Other Work

You are expected to notify the course directors of any anticipated absences. You should make every effort to take the exams on the days they are scheduled. If extenuating circumstances prevent you from taking a scheduled exam, you will need to schedule an appointment to meet with the course directors to identify an alternative exam date. UF attendance policies are detailed in the following link:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Please note: Any requests for make-ups due to technical issues MUST be accompanied by the UF Computing help desk (<http://helpdesk.ufl.edu/>) correspondence. You MUST e-mail me within 24 hours of the technical difficulty if you wish to request a make-up.

Policy Related to Required Class Attendance:

Attendance of lectures is mandatory.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Excused absences must be consistent with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>). Additional information can be found here:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Student Expectations, Roles, and Opportunities for Input:

Expectations Regarding Course Behavior:

Communication Guidelines:

Academic Integrity:

Students are expected to act in accordance with the University of Florida policy on academic integrity. As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge:

“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied:

“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”

It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

Online Faculty Course Evaluation Process:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at

<https://gatorevals.aa.ufl.edu/students/> . Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Policy Related to Guests Attending Class:

Only registered students are permitted to attend class. However, we recognize that students who are caretakers may face occasional unexpected challenges creating attendance barriers.

Therefore, by exception, a department chair or his or her designee (e.g., instructors) may grant a student permission to bring a guest(s) for a total of two class sessions per semester. This is two sessions total across all courses. No further extensions will be granted. Please note that guests are **not** permitted to attend either cadaver or wet labs. Students are responsible for course material regardless of attendance. For additional information, please review the [Classroom Guests of Students policy](#) in its entirety.

Support Services:

Accommodations for Students with Disabilities:

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/> . It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester. The College is committed to providing reasonable accommodations to assist students in their coursework.

Counseling and Student Health:

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The Counseling and Wellness Center 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test

anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>.
On line and in person assistance is available.

- You Matter We Care website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The Student Health Care Center at UF Health is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at UF Health offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- UF Health Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32698, ufhealth.org/emergency-room-trauma-center.
- University Police Department: Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).
- Crisis intervention is always available 24/7 from:

Alachua County Crisis Center:

(352) 264-6789

<http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

Academic Resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services career.ufl.edu/.

Library Support: cms.uflib.ufl.edu/ ask various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall 352-392-2010 or to make an appointment 352 392-6420. General study skills and tutoring. teachingcenter.ufl.edu/

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. writing.ufl.edu/writing-studio/

Student Complaints On-Campus: sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

On-Line Students Complaints: distance.ufl.edu/student-complaint-process