



NEUR 350: Neuropharmacology

Term: Fall 2026

Credits: 3.0

Lecture Times & Location: Tuesday & Thursday 4:00–5:15 p.m., Meridian Science Center 140

Modality: In-Person

Alkimi University is a fictional institution created by Alkimi AI to demonstrate its products. It does not admit students, grant degrees, employ faculty, or accept payments. All people, places, policies, and figures in this document are invented.

Instructor Information

- **Instructor:** Dr. Arjun Iyer (Associate Professor of Neuroscience)
- **Email:** aiyer@university.alkimi.ai
- **Office:** Meridian Science Center 238
- **Office Hours:**
 - Wednesday & Friday: 1:00–2:30 p.m. (In person, Meridian Science Center 238)
 - Monday: 11:00 a.m.–12:00 p.m. (Virtual via Zoom; link posted in Canvas)
 - Also available by appointment.

Course Description

Pharmacokinetics and pharmacodynamics of drugs acting on the nervous system, neurotransmitter systems, psychoactive drugs, addiction, and treatments for psychiatric and neurological disorders. NEUR 350 provides an advanced investigation into the biochemical, physiological, and behavioral actions of pharmacological agents on the central and peripheral nervous systems. Integrating principles of organic chemistry and cellular neuroscience, we explore pharmacokinetics (absorption, distribution, metabolism, excretion) and receptor pharmacodynamics (affinity, efficacy, allosteric modulation). Students examine major classical and peptide neurotransmitter systems, neurochemical mechanisms of drug addiction and tolerance, and modern therapeutic interventions for major depressive disorder, bipolar disorder, schizophrenia, anxiety disorders, epilepsy, Alzheimer's disease, and Parkinson's disease.

Prerequisites

NEUR 201 and CHEM 210.

Measurable Student Learning Outcomes

Upon successful completion of NEUR 350, students will be able to:

1. **Analyze Pharmacokinetic Parameters:** Calculate drug bioavailability, volume of distribution, elimination rate constants, half-life, and steady-state plasma concentrations across different routes of administration.
2. **Evaluate Receptor Pharmacodynamics:** Interpret concentration-response curves, quantify agonist potency (EC₅₀) and efficacy (E_{max}), and differentiate competitive antagonists, noncompetitive antagonists, partial agonists, and positive allosteric modulators.

3. **Examine Neurotransmitter Pathways and Drug Targets:** Detail the synthesis, vesicle packaging, synaptic receptor interactions, and termination mechanisms for cholinergic, monoaminergic, amino acidergic, and peptidergic systems.
4. **Explain the Neurobiology of Addiction and Substance Use:** Differentiate cellular adaptations, dopamine reward circuit sensitization, receptor down-regulation, tolerance, and physical dependence across stimulants, opioids, and sedatives.
5. **Evaluate Psychotherapeutic Mechanisms for Neurological Disorders:** Assess the receptor mechanisms, clinical efficacy, and adverse side effects of antidepressants, antipsychotics, mood stabilizers, anxiolytics, and antiepileptic drugs.
6. **Critique Primary Neuropharmacological Literature:** Critically analyze current empirical studies in neuropharmacology, evaluating experimental pharmacology methodologies, molecular assays, and therapeutic translational validity.

Required Course Materials & Approximate Costs

1. Meyer, Jerrold S., and Linda F. Quenzer. *Psychopharmacology: Drugs, the Brain, and Behavior*. 3rd ed., Oxford University Press, 2019. Approx. \$65 for digital access; approx. \$120 for print purchase.
2. Nestler, Eric J., Steven E. Hyman, Robert C. Malenka, and David M. Holtzman. *Molecular Neuropharmacology: A Foundation for Clinical Neuroscience*. 4th ed., McGraw Hill, 2020. Approx. \$70.
3. **Total estimated cost:** \$65 to \$190.

Generative AI Policy (AI Level 2: AI Permitted with Disclosure for Specified Tasks)

In accordance with Alkimi University Academic Policies (Student Handbook §5.8), NEUR 350 operates under **AI Level 2**.

- **What is permitted:** You may use AI tools to generate molecular flashcards for drug-receptor affinities, clarify pharmacokinetics equations (half-life, volume of distribution, clearance), and check clarity on draft literature reviews.
- **What is prohibited:** You may not submit AI-generated pharmacological mechanism reviews, use AI to answer assigned clinical case studies, or access AI during quizzes or examinations.
- **Disclosure:** On all submitted case studies and the semester neuropharmacology review paper, include a formal disclosure stating which AI tools were consulted and how you verified the biological mechanisms, or confirm that no AI was used.

Grading Components and Weights

- **Midterm Exam 1:** 20% (In class, Thursday, September 24)
- **Midterm Exam 2:** 20% (In class, Thursday, October 29)
- **Clinical Case Studies & Problem Sets:** 20% (Canvas problem sets and case analyses due Fridays at 11:59 p.m. (weeks 2–13; lowest dropped))
- **Neuropharmacology Literature Review Paper:** 15% (Due Friday, November 20 at 11:59 p.m.)
- **Final Comprehensive Examination:** 25% (Thursday, December 17, 2026, 3:30–5:30 p.m.)

Grading Scale (Alkimi University Standard)

- **A:** 93–100% | **A-:** 90–92%
- **B+:** 87–89% | **B:** 83–86% | **B-:** 80–82%
- **C+:** 77–79% | **C:** 73–76% | **C-:** 70–72%
- **D+:** 67–69% | **D:** 60–66% | **F:** Below 60%
- **Extra credit:** No extra credit assignments are offered in NEUR 350.

Course Schedule (Fall 2026)

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 1	Aug 27	Principles of Neuropharmacology and Chemical Neuroanatomy: History of psychopharmacology, synaptic architecture, transmitter criteria, overview of blood-brain barrier anatomy, and drug classification schemes. <i>Reading: Meyer Ch. 1</i>	<i>First day of classes: Wed Aug 26.</i>
Week 2	Sep 1, 3	Pharmacokinetics: Absorption and Distribution: Routes of drug administration, lipid solubility, ionization and pH partition hypothesis, plasma protein binding, and brain capillary tight junctions. <i>Reading: Meyer Ch. 2.1–2.4</i>	<i>Wed Sep 2: Add/section change deadline.</i>
Week 3	Sep 8, 10	Pharmacokinetics: Biotransformation and Clearance: Hepatic cytochrome P450 enzyme metabolism (Phase I and II reactions), enzyme induction/inhibition, first-order versus zero-order clearance, and renal excretion. <i>Reading: Meyer Ch. 2.5–2.8</i>	<i>Mon Sep 7: Labor Day (no classes). Wed Sep 9: Census date (last day to drop without a W).</i>
Week 4	Sep 15, 17	Pharmacodynamics: Receptor Theory and Dose-Response: Receptor binding kinetics, law of mass action, K _d calculations, efficacy versus affinity, full agonists, partial agonists, and inverse agonists. <i>Reading: Meyer Ch. 3.1–3.4</i>	—
Week 5	Sep 22, 24	Intracellular Signal Transduction & Midterm Exam 1: G-protein coupled receptors, cyclic AMP, phosphoinositide signaling, protein kinases, transcription factors (CREB, Fos); Midterm Exam 1 in class. <i>Reading: Meyer Ch. 3.5–3.8</i>	Midterm Exam 1 (in class).
Week 6	Sep 29, Oct 1	Cholinergic Neurotransmission and Alzheimer's Disease: Acetylcholine synthesis (ChAT), vesicular ACh transporter, nicotinic and muscarinic receptors, acetylcholinesterase inhibitors, and cognitive enhancers. <i>Reading: Meyer Ch. 6</i>	—
Week 7	Oct 6, 8	Catecholamines: Dopamine and Norepinephrine Pathways: Tyrosine hydroxylase rate-limiting step, VMAT2, D1- and D2-like receptor families, alpha and beta adrenergic receptors, and transporter targets (DAT, NET). <i>Reading: Meyer Ch. 5</i>	—
Week 8	Oct 15	Serotonergic Neurotransmission and Hallucinogens: Tryptophan hydroxylase, 5-HT receptor diversity (5-HT1 through 5-HT7), SERT reuptake, 5-HT2A agonist psychedelics (LSD, psilocybin), and empathy agents (MDMA). <i>Reading: Meyer Ch. 7 & 15</i>	<i>Oct 12–Oct 13: Fall break (no classes).</i>
Week 9	Oct 20, 22	Glutamatergic Transmission and Excitotoxicity: Glutamine-glutamate cycle, VGLUT, AMPA, kainate, and NMDA receptors, magnesium plug voltage dependence, glycine co-agonist site, and excitotoxic cascades. <i>Reading: Meyer Ch. 8</i>	—
Week 10	Oct 27, 29	GABAergic Transmission, Anxiolytics & Midterm Exam 2: GABA synthesis from GAD, GABA-A receptor chloride channel structure, benzodiazepine and barbiturate allosteric sites; Midterm Exam 2 in class. <i>Reading: Meyer Ch. 8 & 13</i>	Midterm Exam 2 (in class).
Week 11	Nov 3, 5	Endogenous Opioids and Pain Neuropharmacology: Mu, delta, and kappa opioid receptors, endorphins and enkephalins, presynaptic inhibition of substance P, morphine, fentanyl, and naloxone reversal. <i>Reading: Meyer Ch. 11</i>	<i>Fri Nov 6: Last day to withdraw (W) or elect Pass/No Pass.</i>
Week 12	Nov 10, 12	Psychostimulants: Cocaine and Amphetamines: DAT blockade versus reversal of transport (amphetamine), vesicular release mechanisms, behavioral sensitization, and neurotoxicity. <i>Reading: Meyer Ch. 12</i>	—
Week 13	Nov 17, 19	Neurobiology of Addiction and Reward Circuits: Mesolimbic dopamine pathway, ventral tegmental area to nucleus accumbens projections, Delta-FosB transcription, tolerance, dependence, and craving. <i>Reading: Meyer Ch. 10</i>	Neuropharmacology Literature Review Paper due Fri Nov 20 at 11:59 p.m.

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 14	Nov 24	Pharmacotherapy of Affective Disorders: Monoamine hypothesis of depression, neurogenic theory, SSRIs, SNRIs, tricyclics, MAO inhibitors, ketamine/esketamine mechanisms, and lithium in bipolar disorder. <i>Reading: Meyer Ch. 18 & 19</i>	<i>Nov 25–Nov 27: Thanksgiving break (no classes).</i>
Week 15	Dec 1, 3	Pharmacotherapy of Schizophrenia and Psychosis: Dopamine hypothesis of schizophrenia, typical D2 antagonists, extrapyramidal symptoms, atypical 5-HT _{2A} /D2 antagonists, and third-generation partial agonists. <i>Reading: Meyer Ch. 20</i>	—
Week 16	Dec 8	Neurodegenerative Disorders and Semester Review: Levodopa, COMT/MAO-B inhibitors in Parkinson's, NMDA antagonists (memantine) in Alzheimer's, disease-modifying antibodies, and semester synthesis. <i>Reading: Nestler Ch. 18 & Review</i>	<i>Wed Dec 9: Last day of classes. Thu Dec 10: Reading Day.</i>
Finals	Dec 17	Final Comprehensive Examination: Thursday, December 17, 2026, 3:30–5:30 p.m., Meridian Science Center 140.	Comprehensive examination covering pharmacokinetics, receptor dynamics, neurotransmitter systems, and psychotherapeutics.

Course Policies

Attendance Policy

Active attendance and participation in Tuesday and Thursday lecture discussions are expected. Neuropharmacology integrates intricate chemical structures and physiological cascades that are discussed interactively. Notify Dr. Iyer via email in advance of any legitimate excused absences. More than three unexcused absences may reduce your course grade. Students who miss the first two class meetings without notifying the instructor may be dropped. Students may miss class for religious observance without penalty if they notify the instructor in writing within the first two weeks of the semester (by Wednesday, September 9, 2026). Absences for university-sponsored activities (athletics, performances, conferences) are excused with a letter from the sponsoring office at least one week in advance.

Late Work Policy

Clinical case studies and problem sets submitted within 24 hours of the deadline incur a 20% point penalty. Submissions beyond 24 hours late are not accepted as keys are posted promptly. The lowest weekly problem set score will be dropped automatically. The literature review paper loses 10% per day late up to three days.

Final Exam Policy

The final examination (Thursday, December 17, 2026, 3:30–5:30 p.m.) is scheduled by the University Registrar and can't be moved without the Dean's written approval (Faculty Handbook §5.5). A student with three or more final exams on the same calendar day may reschedule one of them. Requests go to the instructor of the middle exam by the last day of classes. For this term, send the request by Wednesday, December 9, 2026 (Student Handbook §6.4).

Academic Integrity

Alkimi University is an academic community devoted to rigorous scholarship, open intellectual inquiry, and uncompromising ethical conduct. All students are subject to the regulations of the Alkimi University Academic Integrity Policy. Academic dishonesty—including plagiarism, cheating on examinations, unauthorized collaboration, fabrication of empirical data, and unauthorized submission of academic work generated by artificial intelligence—undermines the integrity of the university and carries severe disciplinary sanctions. Sanctions range from a failing grade on an assignment or exam to an administrative course failure recorded as an 'XF' on the official transcript, academic suspension, or expulsion. Suspected violations are formally investigated and resolved through the Office of Academic Integrity in accordance

with Faculty Handbook §6. For detailed information, consult the Office of Academic Integrity, Lovell Hall 315, (555) 555-0163, integrity@university.alkimi.ai.

Accessibility Services

Alkimi University is committed to providing equitable educational access and reasonable accommodations for all students with documented disabilities, including physical, sensory, psychological, learning, and chronic health conditions. Students requesting academic accommodations must formally register with the Office of Accessibility Services, Harlan Hall 204, (555) 555-0155, access@university.alkimi.ai. Once approved, students will receive an official Faculty Accommodation Letter detailing approved accommodations. Students should present this letter to the instructor as early in the semester as possible, and at least one week prior to any exam or assignment requiring accommodation. Accommodations cannot be applied retroactively.

Student Wellness and Mental Health

Your physical health, psychological well-being, and mental health are essential to your academic success. If you experience heightened stress, anxiety, depressive symptoms, personal trauma, or academic burnout, free, confidential counseling and medical care are available through the Hollis Health & Counseling Center, located in the Hollis Center. Routine appointments are available Monday–Friday 8:00 a.m.–6:00 p.m. and Saturday 10:00 a.m.–2:00 p.m. during the semester by calling (555) 555-0190 or emailing health@university.alkimi.ai. Urgent, 24/7 crisis psychological counseling is accessible immediately at (555) 555-0199.

Campus Student Support Services

- **Academic Advising Center:** Lovell Hall 101 | (555) 555-0158 | advising@university.alkimi.ai
- **Writing Center:** Whitcombe Library 3rd Floor | Free consultations on papers, reports, and research projects at any stage.
- **Whitcombe Library:** Whitcombe Library, Main Floor | (555) 555-0170 | askalibrarian@university.alkimi.ai
- **Hollis Health & Counseling Center:** Hollis Center | (555) 555-0190 | 24/7 Counseling Line: (555) 555-0199 | health@university.alkimi.ai
- **Science Tutoring Center:** Drop-in peer tutoring and conceptual neuroscience assistance are available Monday through Thursday from 4:00 to 8:00 p.m.