**IMPORTANT: This syllabus form should be submitted to OAA (gsbs_academic_affairs@uth.tmc.edu) a week before the start of each semester.**

**NOTE to STUDENTS:** If you need any accommodations related to attending/enrolling in this course, please contact the Graduate School's 504 Coordinator, Natalie Sirisaengtaksin, PhD. We ask that you notify GSBS in advance (preferably at least 3 days before the start of the semester) so we can make appropriate arrangements.

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| Term and Year: **Fall 2026**<br><br>***Course Number and Course Title:***<br>**GS14 1214: Molecular and Cellular Neuroscience**<br><br>**Credit Hours:** 4<br><br>**Prerequisites:** None<br><br>**Meeting Location:** McGovern Medical School<br><br>**Building/Room#:** MSB B.603 | **Program Required Course: Yes**<br><br>**Approval Code: No**<br><br>**Audit Permitted: No**<br><br>**Classes Begin: August 31, 2026**<br><br>**Classes End: December 9, 2026**<br><br>**Final Exam Week: December 7-11, 2026** |

**Class Meeting Schedule**

| Day | Time |
|---|---|
| **M/W/F** | **9:00-10.20am** |

**Course Director**

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5. Name and Degree: **Yuan Pan, PhD**

Institution: MD Anderson

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**Course Description**: This course is a graduate level treatment of molecular and cellular neuroscience. It will introduce basic concepts of molecular, electrical and chemical signaling in individual neurons, synapses, and local neuronal circuits. Topics covered include the functional properties of membranes, receptors, and channels, intracellular signaling cascades, synaptic transmission and plasticity and the mechanisms underlying brain – cancer crosstalk and neurodegenerative disorders.

**Textbook/Supplemental Reading Materials**

(Textbook copies can be signed out from Amanda Williamson, MSB 7.262): electronic versions may be available through the TMC Library)

- Molecular Cell Biology, Lodish et al., eds. 7th edition
- From Molecules to Networks, Byrne et al., eds. 3rd edition (FMN)
- Cellular and Molecular Neurophysiology, 3rd, Constance Hammond (Academic Press/Elsevier)
- Neuroscience Online: An Electronic Textbook for the Neurosciences, http://nba.uth.tmc.edu/neuroscience/
- Neuron simulation program: MetaNeuron, download at http://www.metaneuron.org/

**Course Objective/s:**

Upon successful completion of this course, students will learn basic concepts of molecular, electrical, and chemical signaling in neurons and synapses.

***Specific Learning Objectives*:**

1. Understand the composition and electrical characteristics of bio-membranes, including their passive and active properties.
2. Understand the structure and function of voltage- and ligand gated ion channels and G-protein coupled receptors.
3. Understand the mechanisms underlying intracellular signaling pathways in neurons and astrocytes
4. Understand the molecular and cellular properties underlying synaptic transmission and synaptic plasticity.
5. Understand the mechanisms mediating brain cancer interactions and Alzheimer's disease

**Student responsibilities and expectations:**

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Students enrolled in this course will be expected to perform the following activities each week.

1. Read assigned readings and review lecture slides prior to each lecture.
2. Attend class and be prepared to discuss possible solutions to questions posed by the lecturer
3. Present assigned science paper as part of a Journal Club
4. Attend and participate in the review sessions prior to exam
5. Complete all homework assignments
6. Prepare for and take each of the three, non-cumulative in-class examinations

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| Students are expected to complete all assigned reading material (reviews and research literature) prior to class. While you may work and discuss all course materials and assignments in groups, all written assignments must be your own. Cheating or engaging in unethical behavior during exams will be grounds for dismissal from the course without credit and further GSBS disciplinary action. |
| **Grading System:** Letter Grade (A-F) |
| **Student Assessment and Grading Criteria**: *(May include the following:)* |

| Percentage | Description |
|---|---|
| Presentations (10 %) | One Journal Club style paper presentation |
| Homework assignments (15%) | Complete and return all assignments before the end of each course block |
| Exams (75%) | Three non-cumulative in-class exams that each count 25% |

**CLASS SCHEDULE (all classes are 9:00-10.20 am)**

**Week 1:**

8-31, M: Introduction to neuronal cell biology **(Stavoe)**

9-2, W: Axons and dendrites **(Stavoe)**

9-4, F: Mechanisms of neuronal homeostasis. **(Stavoe)**

**Week 2:**

9-7, M: Labor day, no class

9-9, W: Membrane composition I – structural/functional roles of lipids –rafts **(Waxham)**

9-11, F: Membrane composition II – Protein-lipid interactions **(Waxham)**

**Week 3:**

9-14, M: Voltage-gated K+-channels **(Waxham)**

9-16, W: Voltage-gated Na+- and $Ca^{2+}$ channels **(Waxham)**

9-18, F: Resting and action potential **(Beierlein)**

**Week 4:**

9-21, M: Mechanism of action potential generation **(Beierlein)**

9-23, W: Molecular basis of electrical signaling, recording techniques **(Beierlein)**

9-25, F: Propagation of action potentials in axons and dendrites **(Beierlein)**

**Week 5:**

9-28, M: Journal Club

9-30, W: review session

10-2, F: exam 1

**Week 6:**

10-5, M: Synaptic cell biology **(Stavoe)**

10-7, W: Molecular signaling underlying neurotransmitter release I **(Waxham)**

10-9, F: Synaptic transmission and short-term plasticity **(Beierlein)**

**Week 7:**

10-12, M: Ligand-gated channels - nAChR and GABA **(Waxham)**

10-14, W: Ligand-gated channels – Glycine/Glutamate **(Waxham)**

10-16, F: G protein coupled receptors and 2$^{nd}$ messengers **(Eckel-Mahan)**

**Week 8:**

10-19, M**:** G protein signaling and enzyme effectors (**Eckel-Mahan)**

10-21, W: G protein signaling and regulation of ion channels **(Eckel-Mahan)**

10-23, F: Ionotropic and metabotropic synaptic signaling **(Beierlein)**

**Week 9:**

10-26, M: Endocannabinoid signaling **(Beierlein)**

10-28, W: Electrical synaptic transmission **(Beierlein)**

10-30, F: Journal Club

**Week 10:**

11-2, M**:** review session

11-4, W: exam 2

11-6, F: Optical recording techniques **(Waxham)**

**Week 11:**

11-9, M: Control of synaptic signaling by astrocytes **(Beierlein)**

11-11, W: Long-term synaptic Plasticity–Induction **(Shouval)**

11-13, F: Long-term synaptic Plasticity–Expression **(Shouval)**

**Week 12:**

11-16, M: Dendritic integration **(Beierlein)**

11-18, W: Neuronal circuits **(Beierlein)**

11-20, F: Cell signaling in pain **(Abe)**

**Week 13:**

11-23, M: Mechanisms of Alzheimer's Disease I **(Ma)**

11-25, W: Thanksgiving break, no class

11-27, F: Thanksgiving break, no class

**Week 14:**

11-30, M: Mechanisms of Alzheimer's Disease II (**Ma)**

12-2, W: Neuro-cancer interactions I **(Pan)**

12-4, F:  Neuro-cancer interactions II **(Pan)**

**Week 15:**

12-7, M: Journal Club

12-9, W: review session

12-11, F: exam 3

*MB/jal-06.26.26*