湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Biochemistry of Cellular Regulation
Course Code	BIOC 4244
Semester	Summer 2026
Course Length	8 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite	BIOL 3211 Cell Biology
Antirequisite	BIOC 4242 Biochemistry of Cellular Regulation (4 Weeks)

Course Description:

This course examines how cells detect, transmit, and integrate biochemical signals to regulate gene expression, development, immunity, and cell division. Core topics include membrane receptor systems, intracellular kinase and second messenger networks, developmental patterning pathways, innate immune cascades, and nuclear transcription factor programs. The course further addresses post-transcriptional regulation by non-coding RNAs and the roles of intercellular vesicle systems in health and disease.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical Thinking Skills** – Students will engage in analytical thinking, demonstrating the ability to critically evaluate, synthesize, and apply knowledge to complex problems, and construct well-reasoned solutions and arguments.
- **Independent Research and Inquiry** – Students will conduct independent research, utilizing academic resources to explore relevant topics, formulating research questions, analyzing data, and presenting findings in a coherent, scholarly manner.
- **Problem-Solving and Application** – Students will apply theoretical concepts and methodologies learned in the course to real-world problems, demonstrating the ability to develop practical solutions informed by academic inquiry.
- **Global and Cultural Awareness** – Students will gain awareness of the global and cultural contexts relevant to the course, appreciating diverse perspectives and considering the implications of their studies in a broader, international context.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Define the structural biology of membranes and their essential role in signal transduction;
- Characterize the biochemical action of major hormones and growth factors;
- Analyze the logic of intracellular cascades, including second messenger systems and kinase networks;
- Explain molecular mechanisms of major signaling pathways and their integration;
- Analyze how non-coding RNAs and exosomes regulate gene expression and intercellular communication;
- Evaluate developmental morphogen pathways and their transport mechanisms;
- Apply concepts to disease states such as cancer and inflammation.

Textbooks/Supplies/Materials/Equipment/ Technology or Technical Requirements:

Primary: Friedrich Marks; Ursula Klingmüller; Karin Müller-Decker (2017). *Cellular Signal Processing: An Introduction to the Molecular Mechanisms of Signal Transduction (2nd Ed). Garland Science.*

Reference: David L. Nelson and Michael M. Cox (2021). *Lehninger Principles of Biochemistry* (8th Edition). W.H. Freeman & Company.

Course Requirements:

Quizzes (10%)
Short quizzes and in-class exercises throughout the semester reinforce key concepts and encourage engagement.

Midterm Examination 1 (20%)
A written examination using multiple-choice, short-answer, and diagram-interpretation formats. Covers foundational signaling cascades: membrane organization, classical receptor systems, kinase modules, and developmental morphogen pathways.

Midterm Examination 2 (20%)
A written examination covering immune and cytokine signaling, nuclear receptor biology, cell cycle transcriptional control, and non-coding RNA mechanisms. Includes data interpretation questions drawn from primary literature.

Literature Review (20%)
Students select and critique one recent primary research article on a signaling topic (e.g., exosomes, miRNA regulation, or morphogen transport), summarizing key findings, evaluating methods, and discussing broader implications. The 4-6 page paper develops scientific writing and critical-thinking skills.

Final Examination (30%)
A comprehensive cumulative exam at the end of the term (covering all lectures) with emphasis on integration of pathways, critical analysis of experimental data, and disease relevance. Format includes problem-solving and essay-style questions.

Assessments: Activity	Percent Contribution
Quizzes	10%
Midterm Examination 1	20%
Midterm Examination 2	20%
Literature Review	20%
Final Examination	30%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	Percentage of available points
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

BIOC 4244 Schedule

Lecture	Topics	Readings
L1	Overview of Cellular Signaling: Logic, Modularity, and Evolution	*Marks* Ch. 1, 3
L2	Energetics and Thermodynamic Principles of Signal Transduction	*Marks* Ch. 2
L3	Membrane Architecture: Lipid Bilayers, Microdomains, and Receptor Platforms	*Nelson* Ch. 11; *Marks* Ch. 3
L4	GPCRs, Heterotrimeric G-Proteins, and Second Messenger Systems	*Marks* Ch. 4-5
L5	Receptor Tyrosine Kinases, Serine/Threonine Kinase Receptors, and Protein Phosphatases	*Marks* Ch. 6-7
L6	Small G-Proteins, MAPK Cascades, and Scaffold-Dependent Signaling	*Marks* Ch. 10-11
L7	PI3K/AKT/mTOR Axis and NF-κB Inflammatory Signaling	*Marks* Ch. 11; *Nelson* Ch. 12
L8	Wnt/β-Catenin Pathway: Receptor Complexes, Cytoplasmic Regulation, and Nuclear Transcription	*Nelson* Ch. 12; *Marks* Ch. 5
L9	Hippo/YAP-TAZ and Contact-Dependent Signaling in Tissue Growth Control	*Marks* Ch. 12; *Nelson* Ch. 12
L10	Hedgehog Signaling: Receptor Mechanisms, Pathway Activation, and Transcriptional Outputs	*Nelson* Ch. 12; *Marks* Ch. 5
L11	Morphogen Gradient Formation and Long-Range Signal	*Marks* Ch. 3;

	Propagation: Mechanisms and Models	Suppl.
L12	Growth Factor Signaling in Vascular Biology: VEGF, Angiogenesis, and Endothelial Cell Responses	*Marks* Ch. 7; *Nelson* Ch. 12
MT 1	**MIDTERM EXAMINATION 1**	Covers L1 - L12
L13	Cytokine Signaling: Receptor Families, Signal Specificity, and Innate Immune Activation	*Marks* Ch. 5; *Nelson* Ch. 12
L14	JAK-STAT Pathway: Receptor Coupling, STAT Activation, Transcriptional Complexes, and Feedback	*Marks* Ch. 5; Suppl.
L15	Pattern Recognition and Innate Immunity: TLR Signaling, NF-κB Activation, and Interferon Induction	*Marks* Ch. 11; Suppl.
L16	Nuclear Receptor Superfamily: Ligand Binding, Co-regulator Recruitment, and Metabolic Gene Control	*Marks* Ch. 8; *Nelson* Ch. 28
L17	Cell Cycle Regulation: Cyclin-CDK Networks, Checkpoint Mechanisms, and Transcription Factor Periodicity	*Marks* Ch. 12; *Nelson* Ch. 12
L18	Transcriptional Control of Cell Cycle Genes: Combinatorial Factor Logic, Co-activators, and Chromatin Dynamics	*Marks* Ch. 12; Suppl.
L19	microRNA Biogenesis, RISC Assembly, and Mechanisms of Post-Transcriptional Gene Silencing	*Nelson* Ch. 28; Suppl.
L20	Experimental Approaches for Mapping RNA-Protein Interactions: Immunoprecipitation and High-Throughput Sequencing Strategies	Suppl.
L21	Non-Coding RNA Regulatory Networks: miRNA-Signaling Crosstalk, Feedback Circuits, and Disease Associations	Suppl.
MT 2	**MIDTERM EXAMINATION 2**	Covers L13 - L21
L22	Non-Coding RNA in Metabolic Regulation: Lipid and Cholesterol Homeostasis, Viral Interactions	*Nelson* Ch. 28; Suppl.
L23	Circular RNA: Biogenesis, Structural Properties, miRNA Sponge Activity, and Physiological Roles	Suppl.
L24	Extracellular Vesicles: Biogenesis Pathways, Cargo Sorting, Release Mechanisms, and Uptake	*Marks* Ch. 5; Suppl.
L25	Vesicle-Mediated Signaling in Cancer and Inflammation; Integrated Pathway Analysis	Suppl.
	Literature Review Due	
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Accommodation Statement:

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention, as he/she is not legally permitted to inquire. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or outside the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations

All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates

All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work

The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities

Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.