

SYLLABUS: PHYSICS OF LIVING SYSTEMS

Course Information

Course Description:

This course provides an introduction to the interdisciplinary study of biological systems through the lens of the physical sciences. Students will learn how discovery-driven research between biology and physics leads to biomimetic advances, in a way complimenting direct application-based biomimicry. We will review recent research in bio-inspired engineering before focusing more deeply on areas of local interest: optical and mechanical lessons from biological systems. The optics module will provide a background in the physical nature of light and demonstrate how the basic principles of ray and wave optics are utilized by organisms for (visual and non-visual) perception as well as communication (eg. luminescence and structural color). The materials module will introduce concepts of mechanical characterization and demonstrate how organisms tune material properties for particular goals, such as traction, underwater adhesion, prey capture, and nest-building.

Prerequisites: None

Objectives: Upon successful completion of the course you should:

1. Possess a general impression of the current field of bio-inspired engineering
2. Understand how light is generated and manipulated
3. Understand how images are formed and colors generated by structural elements
4. Understand concepts relevant to material characterization
5. Understand concepts relevant to adhesion
6. Understand how structures derive their bulk mechanical properties
7. Understand how evolution of biological systems incorporates these concepts
8. Be able to apply above understanding to real-world problems
9. Be able to communicate interdisciplinary research to general audiences

Textbook: None required. Readings will be provided.

Topic outline:

Week	Topic
1	Introduction to interdisciplinary science
2 3	Review of bio-inspired engineering
4	Principles of Module 1: OPTICS
5 6	Perception – imaging to polarization sensing
7 8	Communication – luminescence to structural color
9	Principles of Module 2: MATERIALS
10 11	Adhesion – gecko feet and mussel byssus
12 13	Mechanical structures – spider webs and bird nests
14 15	Student presentations

Evaluation and Assessment

Grading scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
> 92	90-92	86-89	83-85	80-82	76-79	73-75	70-72	66-69	63-65	60-62	< 60

Breakdown of final grade:

Weekly reading commentaries (Team)	30 pts
Quizzes (Individual)	30 pts
Presentation (Team)	20 pts
Final exam (Individual, comprehensive)	20 pts
<u>Total</u>	<u>100 pts</u>

1. **Reading commentaries** (30% of final grade):

Supplementary reading will be assigned weekly. The material will be discussed out-of-class in teams assigned in-class. Thoughtful commentary on the content (critique, open questions) will be collected from each team and coarsely assessed.

2. **Quizzes** (30% of final grade):

Brief in-class assignments will be done approximately once a week. Students will be able to discuss the questions, but will individually turn in answers in class. These assignments will be primarily used to stimulate discussion and aid digestion of lecture material, but will also be evaluated for a grade.

3. **Presentation** (20% of final grade):

Within the first half of the course, teams will be formed for a final research project. Each team will choose a topic of research within the scope of the course, but not explored in the lectures. Each team will present its topic in the form of informal research seminar, and will be evaluated by its effectiveness, clarity, and accessibility.

4. Final exam (20% of final grade):

One traditional exam will be given at the end of the semester, which will measure comprehension of concepts and key information from the course.

Additional Information

Required Texts: There is no required text for this class. Readings will be provided in Brightspace.

Instructor Contact and Reply Policy:

As the teacher of this class, I will:

- Log on to the course website at least once a day to answer questions, check in with discussions, and provide feedback on assignments.
- Read all discussions and assignments, providing feedback to help extend learning and answer questions.
- Answer e-mails and respond to discussion board “Help!” questions within 24 hours during weekdays and 48 hours over weekends and holidays (unless otherwise announced).

Technical Support:

If you have technical questions or require technical assistance, please contact ZipSupport:

→ By Phone: 330-972-6888

→ By Email: support@uakron.edu.

The ZipSupport Help Desk web site can be found [here](#).

Brightspace self-help guides can be found [here](#).

Academic Support: The Writing Lab and eTutoring:

The University of Akron provides both on ground and online help with writing.

The Writing Commons, Writing Lab, and Writing Center:

The University of Akron provides free assistance to currently enrolled students at two main campus locations as well as Wayne College. Select the location name to access the website of each.

[Bierce Writing Commons](#)

Bierce Library, room 68

For Appointments, Call (330) 972-6548

Day and Evening Appointments Available

[Polsky Writing Lab](#)

303 Polsky Building

For Appointments Call (330) 972-7046

Day and Evening Appointments Available

[Wayne College Writing Center](#)

Smucker Learning Center

For appointments call (330) 684-8960

eTutoring

The University of Akron also offers online tutoring, called eTutoring, which is provided through the Ohio eTutoring Collaborative. Students at The University of Akron have access to online tutoring in Writing, Accounting, Chemistry, Math (through Calculus II), and Statistics. The Online Writing Lab allows you to submit a draft of your paper to a tutor, ask for specific feedback, and receive your work back with a tutors comments in approximately 24 to 48 hours. You may submit up to three drafts per paper. eChat will allow you to meet with a tutor in one-on-one tutoring sessions via a fully interactive, virtual online environment. Offline questions will allow you to leave a specific question for an eTutor, who will respond within 48 hours (but usually sooner). Select this link to learn more about eTutoring services.

Accessibility Statement

Any student who has a disability that substantially limits learning in a higher education setting may contact the Office of Accessibility for information regarding eligibility for reasonable accommodations. The office telephone number is (330) 972-7928 (Voice) or (330) 972-5764 (TDD). Etiquette for use of Brightspace

1. Avoid language that may come across as strong or offensive. Language can be easily misinterpreted in written communication. If a point must be stressed, review the statement to make sure that an would not be offended; then post the statement. Humor and sarcasm may easily be misinterpreted, so try to be as matter-of- fact and professional as possible.
2. Keep writing to a point and stay on topic. Online courses require a lot of reading. When writing, keep sentences focused and brief so that readers do not get lost in wordy paragraphs and miss the point of the statement. Also, do not introduce new topics; it may just confuse the readers.
3. Read first, write later. Read all posts or comments before personally commenting to prevent repeating commentary or asking questions that have already been answered.
4. Review, review, then send. Theres no taking back a comment that has already been sent, so it is important to double-check all writing to make sure that it clearly conveys the exact intended message.
5. An online classroom is still a classroom. Though the courses may use an online tool, appropriate classroom behavior is still mandatory. Respect for fellow classmates is always important.
6. The language of the Internet. Do not write using all capital letters, because it will appear as shouting. Also, the use of emoticons can be helpful to convey nonverbal feelings (example: :-) or :- (), but avoid overusing them.
7. Consider the privacy of others. Ask permission prior to giving out a classmate's email address or other information.
8. If possible, keep attachments small.