

Syllabus for BINF740: *Introduction to Biophysics*

Course title: Introduction to Biophysics

Course number: BINF740

Instructor name: Dmitri Klimov

Semester and year: Spring 2026

Course credits: 3

Class meeting day/time/modality: Thursdays, 4:30 pm - 7:10 pm, hybrid

Class website: Canvas 16003.202610 BINF-740-DL1 (Spring 2026) or Canvas 15850.202610 BINF-740-001 (Spring 2026)

Class zoom invitation: Provided via email and Canvas

Instructor email address: dklimov@gmu.edu (preferred way of communication)

Instructor telephone number: 703-993-8395

Instructor office location: Colgan Hall, Rm 328B, Science and Technology Campus

Instructor office hours: By appointment (email to arrange zoom meeting or to speak over the telephone)

Course Description and Goals

This graduate course is designed as a broad introduction into the field of biophysics for graduate students with backgrounds in chemistry, physics, computer science, or biology. The goal of the course is to present the concepts of physical chemistry and map them on a rapidly expanding interdisciplinary interface, combining biology, chemistry, and physics. The course aims to balance the need for rigorous mathematical treatment with the simplicity of presentation.

The course consists of three parts. The first part introduces students to the fundamental concepts in physical chemistry, which are commonly used in the description of biological systems. Two other parts demonstrate a multiscale nature of biophysics by exploring *macroscopic* and *microscopic* applications. The use of computational approaches is emphasized.

Part I introduces the basic notions of thermodynamics, statistical mechanics, and physical kinetics. Molecular interactions, ranging from covalent bonding to electrostatic and van-der-Waals interactions, are thoroughly discussed. The course then shows how these interactions are combined to produce a complex array of biomolecular structures found in DNA, RNA, and proteins.

Part II describes several important *macroscopic* aspects of biophysics. The energetics of living systems is studied, including energy consumption, photosynthesis, and ATP production. The fundamental role of biomembranes is investigated in detail. Other important topics, such as nerve signals, memory function, and biomechanics, are introduced.

Part III focuses on several important *microscopic* aspects of biophysics. This part reveals the mystery of protein folding and the function of cellular chaperone systems assisting proteins to fold. The phenomenon of protein misfolding and aggregation is

discussed and linked to a new class of diseases. The unfolding of proteins implicated in a variety of biological processes is investigated.

Prerequisites: Students are expected to be familiar with basic concepts of physics, calculus, and biology on undergraduate level.

Required Reading

Required textbooks:

1. Rodney Cotterill “Biophysics: An Introduction” (for parts I and II of the course). The price of eTextbook is \$90.00 on Amazon.
2. Roland Glaser “Biophysics: An Introduction”, 1st or 2nd editions (for parts I and II of the course). The price of eTextbook is \$54.99 on Amazon.

Online lecture notes will be distributed for part III of the course.

Course Policies

Grading schema (percentage): A+ (>100), A (90-100), B (80-89), C (\leq 79). Percentages are not rounded to the closest whole number.

Grade weights and grading policy: Students will be graded on the basis of homework (30%), final take-home exam (40%), and class participation (30%). Class participation implies asking questions during lectures. For each problem, student will earn up to one point. Homeworks are weighted equally independent of the number of problems in the homework.

Campus Closure: If the campus closes or class is canceled due to weather or other concern, students should check Canvas and/or contact instructor for updates on how to continue learning and information about any changes to events or assignments.

Participation and make-up work: In case of illness or quarantine, please contact the instructor to set up a plan for make-up work. Late assignments will not be accepted unless due to emergency, illness, quarantine, work-related or other documented reasons.

Course Recordings: All synchronous meetings in this class will be recorded to provide necessary information for students in this class. Recordings will be stored on Zoom cloud and will only be accessible to students taking this course during this semester.

Other considerations: If there are any schedule issues related to religious holidays, please inform the instructor during the first week of the class. Completion of regular weekly homework is expected to take several hours.

Learning Outcomes

By the end of this course, students will be able to

1. Apply fundamental physical principles and concepts to biological phenomena.

2. Recognize multiscale nature of biophysics, from molecular to cellular and organism levels.
3. Appraise recent nanoscale advances in biophysics.
4. Apprehend synergistic contributions of theory, experiment, and computer simulation to the field of biophysics.

Course Logistics

The course uses Canvas for distributing lecture materials, submission of homework, and grading.

To access Canvas

1. Go to <https://canvas.gmu.edu>
2. Login using your Mason ID and password.
3. Click on the ‘Courses’ tab.
4. Select BINF-740-DL1 (Spring 2026) or BINF-740-001 (Spring 2026) from the list of courses.

The course uses Zoom for online meetings. The Zoom invitation information is provided via email but is also included as module items. Most classes will be held entirely online except for hybrid sessions indicated in the schedule in the end of this syllabus.

Technology Requirements for the Course

Software and Hardware: This course uses Canvas as a learning management system available at <https://canvas.gmu.edu>. This course uses web-conferencing Zoom software for online meetings. Students are required to have regular, reliable access to a computer with an updated operating system (recommended: Windows 11 or Mac OSX 10.13 or higher) and a stable broadband Internet connection (cable modem, DSL, satellite broadband, etc.). In addition, students are required to have a device with a functional camera and microphone. A larger screen is recommended for better visibility of course material. In an emergency, students can connect through a telephone call, but video connection is the expected norm.

Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types.

Technical Help: If you have difficulty with accessing Canvas or Zoom, please contact the ITS Support Center at 703.993.8870 or support@gmu.edu. If you have trouble with using the features in Canvas, email courses@gmu.edu.

Common Policies Addendum

The course follows Common Policies Addendum available at <https://stearnscenter.gmu.edu/home/gmu-common-course-policies/>. Further information on policies is provided below.

Student Responsibilities

Mason Email: Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communications from the university, college, school, and program will be sent to students solely through their Mason email account.

Students with disabilities: Students with disabilities who seek accommodations in a course must be registered with the George Mason University Disability Services and inform their instructor, in writing, at the beginning of the semester [See Disability Services website: <https://ds.gmu.edu/>].

Academic integrity: Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture [See Academic Standards website: <https://academicstandards.gmu.edu/>].

Academic Standards Code and Virtual Classroom Conduct: Students must adhere to the guidelines of the George Mason University Academic Standards Code [See Academic Standards Code website: <https://academicstandards.gmu.edu/academic-standards-code/>].

Use of AI tools: Use of generative AI (e.g., ChatGPT) in homework is not allowed. If students use these tools for other purposes, they must follow GMU academic standards and make appropriate citations.

Academic Honesty Policy of the course: Students are expected to follow the Honor Code. Academic dishonesty will not be tolerated in this class. Exams, projects, and homework must reflect individual work. If you have difficulty with them, discuss it with the instructor.

University policies: Students must follow the university policies [See University Policies website: <https://universitypolicy.gmu.edu/>].

Responsible use of computing: Students must follow the university policy for Responsible Use of Computing [See University Policies website: <https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>].

University calendar: Students should consult the current Academic Calendar [See University Calendar website: <https://www2.gmu.edu/academics/academic-calendar/>].

University catalog: Students should use the current university catalog [See University Catalog website: <http://catalog.gmu.edu>].

Student Services

Writing center: The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. (See Writing Center website: <http://writingcenter.gmu.edu>). **ESL Help:** The program was designed specifically for students whose first language is not English who feel they might benefit from additional, targeted support over the course of an entire semester.

University libraries: University Libraries provide resources for distance learning students [See Library website: <http://library.gmu.edu/for/online>].

Counseling and Psychological Services: The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See Counseling and Psychological Services website: <https://caps.gmu.edu>].

Family Educational Rights and Privacy Act (FERPA): The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See Registrar's Office website: <https://registrar.gmu.edu/privacy>].

Course Materials and Student Privacy

Video recordings of class meetings that are shared only with the instructors and students officially enrolled in a class do not violate FERPA or any other privacy expectation. Video recordings that only include the instructor (no student names, images, voices, or identifiable texts) may be shared without violating FERPA (but see University Policies: Privacy for some qualifications and recommendations). All course materials posted to Canvas or other course site are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.

Video conferencing or recordings: Video recordings - whether made by instructors or students - of class meetings that include audio, visual, or textual information from other students are private and must not be shared outside the class. Live video conference meetings that include audio, textual, or visual information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class.

Course schedule for Spring 2026

Lecture 1, Jan 22

Introduction to thermodynamics and statistical mechanics.

Lecture 2, Jan 29

Reaction kinetics and transport processes. Connecting thermodynamics and kinetics.

Lecture 3, Feb 5

Biomolecular energies, forces, and bonds.

Lecture 4, Feb 12

Biomolecular structure: DNA, RNA, polypeptides.

Lecture 5, Feb 19

Biological energy: Energy consumption, photosynthesis, ATP.

Lecture 6, Feb 26

Biological membranes.

Lecture 7, Mar 5

Nerve signals.

Lecture 8, Mar 19 (hybrid meeting)^a

Memory

Lecture 9, Mar 26 (hybrid meeting)^a

Biomechanics

Lecture 10, Apr 2

Protein folding.

Lecture 11, Apr 9

Molecular chaperones.

Lecture 12, Apr 16

Protein aggregation.

Lecture 13, Apr 23

Mechanical unfolding.

Lecture 14, Apr 30

1. Molecular crowding.
2. Transition state in protein folding.

a) During hybrid meetings DL section of the course continues to meet online, while the f2f section meets on campus.

Notes:

1. Each lecture is a 2 hours 40 minutes presentation with a 5-minute break.
2. Final exam will be held during the exam week.