NEW COURSE PROPOSAL
Undergraduate Programs

FLORIDA ATLANTIC UNIVERSITY

Department Biological Sciences

College Sciences

*(To obtain a course number, contact **erudolph@fau.edu**)*

UUPC Approval 12-2-24
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner Posted _____
Catalog _____

Prefix BSC

Number 4884

(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)

Lab Code

Type of Course Lecture

Course Title Introduction to Biological Networks

Credits *(See Definition of a Credit Hour)* 3

Grading *(Select One Option)* **Regular** ◉

Effective Date *(TERM & YEAR)* Spring 25

Sat/UnSat ○

Course Description *(Syllabus must be attached; see Template and Guidelines)*
Discover how network science and complexity theory can be used to study biological systems. This course introduces mathematical tools and concepts applied to topics like disease epidemiology, ecology, and evolution, offering a foundation for understanding complex biological scenarios.

Prerequisites, with minimum grade*
None

Corequisites
None

Registration Controls *(Major, College, Level)*
None

***Default minimum passing grade is D-.** **Prereqs., Coreqs. & Reg. Controls are enforced for all sections of course**

WAC/Gordon Rule Course

☐ Yes ☑ No

WAC/Gordon Rule criteria must be indicated in syllabus and approval attached to proposal. See WAC Guidelines.

Intellectual Foundations Program (General Education) Requirement *(Select One Option)*

None

General Education criteria must be indicated in the syllabus and approval attached to the proposal. See Intellectual Foundations Guidelines.

Minimum qualifications to teach course
Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field).

Faculty Contact/Email/Phone
afahimipour@fau.edu / 850.545.0034 (cell)

List/Attach comments from departments affected by new course
NA

Approved by	*Date*
Department Chair SL Mattson	11-18-24
College Curriculum Chair	11-19-24
College Dean	11-20-24
UUPC Chair ~~Korey Sorge~~	12-2-24
Undergraduate Studies Dean Dan Moerhoff	12-2-24
UFS President	
Provost	

Email this form and syllabus to mjenning@fau.edu seven business days before the UUPC meeting.

FLORIDA ATLANTIC UNIVERSITY

BSC 4884

Introduction to Biological Networks

Date: Day, Time
Building: NA **Room:** NA

3 Credit(s)

Semester Year - 1 Full Term

Instructor Information

Instructor: Ashkaan Fahimipour
Email: afahimipour@fau.edu
Office: Sanson 206
Office Hours: Day and time

Course Topical Outline

Unite	Topics	Assignments	Date
What are complex systems?	Example complex biological systems, and how we understand and model them	Code companion 1	1/9
Networks describe the world	Intro. to network science, greedy algorithms for efficient transport networks, spanning trees, adjacency matrices	HW 1	1/16
	Shortest paths through a landscape, finding efficient movement routes, visualization with R and *igraph*	Code companion 2	1/23
	Small worlds in social networks, friendship paradox *or* "why your friends have more friends than you"	HW 2, Reading 1	1/30
	Degree distributions in networks, simulating the spread of changing opinions on social networks	Reading 2	2/6
Changes *on* and *of* networks	Intro. to dynamical systems, equations for population growth	HW 3	2/13
	2 and 3 dimensional continuous-time ecosystems with predators and prey and plants	Code companion 3	2/20
	Stability analysis and Jacobian matrices for food webs	Midterm project proposal	2/27
	Bifurcations, coarse-graining animal behavior into equations, eigensolutions	HW 4, Reading 3	3/12
	Equations for heat and vibrations for modeling migrating animals, classifying biological datasets, fragmenting landscapes *or* the minimal cut	HW 5	3/19
	Impact and sensitivity to ecological perturbations, Laplacian matrices for modeling migration	Reading 4	3/26
Applications to data	Data visualization	HW 6	4/2

	The curse of dimensionality, manifold learning applied to genomic data	Reading 5	4/9
Complex systems thinking	Applications of complex systems science in microbiology, ecology, evolutionary biology, epidemiology, archaeology, social sciences, and other fields	HW 7	4/16
	Applications II	Reading 6	4/23
		Final project	Finals

Instructional Method

In-Person

Traditional concept of in-person. Attendance is mandatory.

Catalog Description

Discover how network science and complexity theory can be used to study biological systems. This course introduces mathematical tools and concepts applied to topics like disease epidemiology, ecology, and evolution, offering a foundation for understanding complex biological scenarios.

Course Description

This undergraduate course introduces the fundamentals of network science and complexity with a specific focus on biological systems. Students will explore core concepts like network structures, stability analysis, and dynamic interactions, examining how these principles apply to biological phenomena such as metabolic pathways, the spread of disease on social networks, neural networks, and ecological systems. Through computational examples, students will analyze existing biological models and gain hands-on experience in applying complexity science to biological contexts. Coursework includes problem sets and a final project where students either review biological complexity literature or make tailored modifications to models, preparing them for advanced research in biological complexity and systems biology.

Course Objectives/Student Learning Outcomes

By the end of this course, students will be able to model biological systems using foundational network science principles and analyze biological data sets to gain insights into biological phenomena. They will develop essential skills in interpreting network structures and dynamics within complex biological systems, applying computational and mathematical models to study processes such as gene regulation, species interactions, and cellular networks. Students will engage in discussions focused on biological applications, create and modify simple code relevant to biological datasets, and complete a final research project that includes a brief seminar presentation on a biologically relevant topic.

Special Course Requirements

We will use computer software in this course to perform computer simulations. To do this, you will need to interact with computer code in the R programming language. I recommend that you use the RStudio or VSCode IDEs to do this. An IDE (Integrated Development Environment) is an app that provides a comprehensive set of tools for interacting with a programming language, including editing tools, debugging, and creating data visualizations. You can get a head start by installing these pieces of software on a laptop or desktop computer that you can access throughout the term. You need to install the R language, *before* installing RStudio.

R can be downloaded for your Operating System from this east coast mirror: https://mirrors.nics.utk.edu/cran/.

RStudio (Free Desktop Edition) can be downloaded here: https://posit.co/downloads/. If you already have programming experience, you may feel free to use your preferred language to complete assignments or your final project *e.g.*, Python, Julia, C++. You may also prefer alternate IDEs. For instance, almost all of my work is done in Julia (*my favorite!*) using VSCode (IDE).

Required Texts/Materials

No textbook is required for this course.

Introduction to the Modeling and Analysis of Complex Systems
ISBN: 9781942341093
Authors: Hiroki Sayama
Publication Date: 2023-11-28
This text is not required, but it covers a lot of relevant topics and you may enjoy it.

Networks
ISBN: 9780192527493
Authors: Mark Newman
Publisher: Oxford University Press
Publication Date: 2018-07-04
This text is not required, but it covers a lot of relevant topics and you may enjoy it.

Faculty Rights and Responsibilities

Florida Atlantic University respects the rights of instructors to teach and students to learn. Maintenance of these rights requires classroom conditions that do not impede their exercise. To ensure these rights, faculty members have the prerogative to:
• Establish and implement academic standards.
• Establish and enforce reasonable behavior standards in each class.
• Recommend disciplinary action for students whose behavior may be judged as disruptive under the Student Code of Conduct University Regulation 4.007.

Disability Policy

In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU's campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at www.fau.edu/sas/.

Course Evaluation Method

Grades are based on [i] homework problem sets (50%), [ii] a midterm project proposal (15%), and [iii] a final project (25%) delivered to the class, in addition to [iv] in-class participation points (10%).

Homework

Approximately 6 problem sets will be due in this course. Undergraduate students will be evaluated on their understanding and application of the core principles of network science. Homework problems will focus on reinforcing class concepts, requiring students to perform basic computations, modify in-class models, or solve well-defined questions. Solutions should clearly demonstrate comprehension of key methods without needing to extend them. Some assignments may involve code development but will focus more on interpreting results and less on developing original methods. Problem sets will contain questions with 2 tiers of difficulty. *Undergraduate students are only required to complete tier 1 problems.* Assignments will be due 1 week after the relevant material has been covered. Students may collaborate on assignments outside of class on things like access to computers, installing software, debugging computer code, etc. But, answers to problems should be your own. Homework will be posted on the course website, and can be submitted as a PDF made with a medium of your preference. This includes hand-writing on paper, creating a PDF from a Google Doc / Microsoft Word / Apple Pages document, or using a typesetting language like LaTeX (https://www.latex-project.org/) on a service like Overleaf (https://www.overleaf.com/) (*my favorite*). You will need access to a computer to complete assignments.

Final project

Undergraduate students will focus on a comprehensive review of a complexity science topic covered in class. They may propose future research directions or make modest modifications to existing models and tools. This could involve simplifying model assumptions, testing hypotheses with variations of provided datasets, or analyzing case studies. Students will submit a written report and give an oral presentation summarizing their project outcomes and relevance to the field.

Course Grading Scale

Letter Grade	**Letter Grade**
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	63 - 66%
D-	60 - 62%
F	Below 60

Code of Academic Integrity

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001. **Please *do not* cheat**. It is difficult to cheat in this course, anyway. I advise you to especially avoid using LLMs (*e.g.*, ChatGPT), AI language models do not do well in this course since they cannot perform advanced quantitative reasoning.

Attendance Policy Statement

Students are expected to attend all their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance. Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations, or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances, and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a

reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade. Absences may result in a 5% reduction per unexcused absence from participation points. Legitimate reasons must be reported beforehand.

Attendance is mandatory. But, please do ***stay home*** if you are sick. This class is built on mutual respect, and so I will assume absences are legitimate, including but not limited to illness, family emergencies, university obligations, *etc.* Lecture slides and course materials will be made available electronically.

Religious Accommodation Policy Statement

In accordance with the rules of the Florida Board of Education and Florida law, students have the right to reasonable accommodations from the University in order to observe religious practices and beliefs regarding admissions, registration, class attendance, and the scheduling of examinations and work assignments. University Regulation 2.007, Religious Observances, sets forth this policy for FAU and may be accessed on the FAU website at www.fau.edu/regulations. Any student who feels aggrieved regarding religious accommodations may present a grievance to the executive director of The Office of Civil Rights and Title IX. Any such grievances will follow Florida Atlantic University's established grievance procedure regarding alleged discrimination.

Time Commitment Per Credit Hour

For traditionally delivered courses, not less than one (1) hour of classroom or direct faculty instruction each week for fifteen (15) weeks per Fall or Spring semester, and a minimum of two (2) hours of out-of-class student work for each credit hour. Equivalent time and effort are required for Summer Semesters, which usually have a shortened timeframe. Fully Online courses, hybrid, shortened, intensive format courses, and other non-traditional modes of delivery will demonstrate equivalent time and effort.

Grade Appeal Process

You may request a review of the final course grade when you believe that one of the following apply:
• There was a computational or recording error in the grading.
• The grading process used non-academic criteria.
• There was a gross violation of the instructor's own grading system.

University Regulation 4.002 of the University Regulations contains information on the appeals process

Policy on Make-up Tests, Late work, and Incompletes

Late work will not be accepted unless prearranged or in the case of emergencies with documentation.

Policy on the Recording of Lectures

Students enrolled in this course may record video or audio of class lectures for their own personal educational use. Recordings may not be used as a substitute for class participation or class attendance and **may not be** shared. Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct.

Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to

help improve and maintain emotional well-being. For more information, go to http://www.fau.edu/counseling/

Student Support Services and Online Resources

- Center for Learning and Student Success (CLASS)
- Counseling and Psychological Services (CAPS)
- FAU Libraries
- Math Learning Center
- Office of Information Technology Helpdesk
- Center for Global Engagement
- Office of Undergraduate Research and Inquiry (OURI)
- Science Learning Center
- Speaking Center
- Student Accessibility Services
- Student Athlete Success Center (SASC)
- Testing and Certification
- Test Preparation
- University Academic Advising Services
- University Center for Excellence in Writing (UCEW)
- Writing Across the Curriculum (WAC)

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider using FAU's Counseling and Psychological Services (CAPS) Center. For more information, go to www.fau.edu/counseling/ or you can **talk to me at any time**, and I will help you make arrangements.