# Physics 471D -- Advanced Topics: Nonlinear Dynamics -- Spring 2020

| Instructor       | Renate Wackerbauer,  
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| **Open office hours** | Walk-ins are very welcome; appointments help; email is effective for straightforward questions. |
| **Course info** | Phys471D, 1 credit |
| **Prerequisites** | Phys220 and Phys301, or instructor's permission |
| **Lectures** | MW 4:40-5:40pm, REIC 207  
| | F 3:30 to 4:30 pm, REIC 207  
| | The lectures will explore in depth material presented in the text |
| **Noyes Lab** | Access to the Noyes Computer Lab (Rm 101 REIC) is provided to all students enrolled in a Physics course. Your polar express card lets you in. |
| **Text** | **Required text:**  
| | (book is available as hard copy and as electronic copy at Rasmuson Library)  
| | **Supplementary readings:**  
| | --many nice applications, and great explanations.  
| | --on nonlinear dynamics with particular focus on biological systems  
| | There are many books on nonlinear dynamics in the library. Please explore them to see different approaches to our topics. |
| **Course Content** | Introduction into the dynamics of nonlinear systems. Continuous and discrete dynamical systems, stability analysis, bifurcations, limit cycle, chaos and strange attractors, fractals and dimension algorithms. |
| **Course Goals** | This course provides an introduction into nonlinear dynamics at the undergraduate level. Dynamical systems that are characterized with coupling and feedback processes often show dynamical (or spatiotemporal) patterns that need to be described at the systems level; a reductionist approach is not suited for complex systems, since the entire system behaves different than the sum of its part. Complex systems can be high-dimensional but must not. A necessary requirement for complex dynamics is nonlinear equations of motion. |
| **Student Learning Outcomes** | Students learn,  
| | *how to analyze the stability of complex systems  
| | *how nonlinear systems differ from linear systems regarding dynamical properties  
| | *how sensitivity of system dynamics is related to predictability, determinism, and control  
| | *to explore dynamical systems analytically and with computer simulations  
| | Homework will be assigned weekly and will be due by 3:30 pm on the following
Homework

Homework assignments will be posted in the glass case in the Physics Department hallway. I HIGHLY appreciate it, if you RECYCLE paper for your homeworks!

Examinations

A one-hour in-term final examinations will be held during the semester. The exam will be closed books and closed notes. No calculators, computers, or communication devices are allowed.

| Final exam | Monday, February 17, in class | Strogatz, approx chapt 2, 3, 5-10 |

Grading

The maximum score for each homework will be 100 points. A solution (homework, exam) that presents nothing more than a restatement of the problem will receive zero credit. Credit will be given for clarity of presentation, illegible work will not be graded. To pass the course with a grade higher than an "F", you need 50% of the total credits. Grades A - D are assigned equal weight (units of 12.5%) for total credits between 50% and 100%. +/- are assigned 2.5% from grade boundary. So A+ (>97.5), A (>90), A- (>87.5), B+ (>85), B (>75), B- (>72.5), C+ (>72.5), C (>65), C- (>62.5), etc. For the final grade homework, exams, will be weighted as follows:

| Homework | 70% |
| Final exam | 30% |

Course policies

Attendance at lectures is expected. Active class participation, questions, comments are extremely welcome in the lectures. A missed exam will receive 0 credit unless the instructor is notified by email, phone, etc before the exam starts. Make-up exams will be individually scheduled with the student.

Student Obligations

As students of UAF, you are bound by the policies and regulations of the University of Alaska, UAF rules and procedures, and the Student Honor Code. You are obligated to make yourselves familiar with all conditions presented in the UAF Catalog. Plagiarism on homework, or on exam will result in a failing grade.

Disabilities Services

The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. If you have any kind of dissability, please ensure that you go to the disabilities services program coordinator. I will work with the office of disabilities services (208 WHIT, 474-5655) to provide reasonable accomodations to students with disabilities.

Title IX

University of Alaska Board of Regents have clearly stated in BOR Policy that discrimination, harassment and violence will not be tolerated on any campus of the University of Alaska. If you believe you are experiencing discrimination or any form of harassment including sexual harassment/misconduct/assault, you are encouraged to report that behavior. If you report to a faculty member or any university employee, they must notify the UAF Title IX Coordinator about the basic facts of the incident. Your choices for reporting include: 1) You may access confidential counseling by contacting the UAF Health & Counseling Center at 474-7043; 2) You may access support and file a Title IX report by contacting the UAF Title IX Coordinator at 474-6600; 3) You may file a criminal complaint by contacting the University Police Department at 474-7721.