SYLLABUS for course PHYD38, Title: Nonlinear Physics and Chaos, Winter 2017

Lectures (L) on Mo. in BV 363, 10:00-12:00

Tutorials (T) on Mo. in BV 359, 14:00-15:00

January	February	March	April
2 [L1+2,no tutorial]	6 [L11+12,T5]	6 [L17+18,T8]	20 [final exam]**)
9 [L3+4,T1]	13 [L13+L14,T6]	13 [L19+20,T9]<-deadline set#3	
16 [L5+6,T2]	20 -- reading wk	20 [L21+22,T10]	
23 [L7+8,T3]	27 [L15+L16),T7*]	27 [L23+24,T11]<-deadline set#4	
30 [L9+10,T4]			

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*) - midterm, in class, 55 min. We'll start as close to 14:05 as we can.

**) 20.04.17 19-22, MW120

Notes:

This syllabus will change slighty during the course, please download the updates every week. Numbers in square brackets give chapters in the Strogatz book.

0. Introduction to the course structure and requirements

INTRODUCTION - DYNAMICAL SYSTEMS AND CHAOS

1. Chaos, Fractals and Dynamics and the
   Importance of being nonlinear [1]
2. 1-D Flows
   Flows on a line [2]
   Bifurcations [3]
   Catastrophes [3]
   Flows on a circle [4]
3. 2-D Flows
   Linear systems [5]
   Phase plane portraits [6]

Limit cycles [7]

Bifurcations again [8]

4. Chaos

Lorenz Equations [9]

1-d maps [10]

Fractals [11]

The exponential fractal

Strange attactors [12]

5. Nonlinear data analysis

Machine Learning, Machine Intelligence

Neural Networks

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Postscript:

NONLINEAR WORLD - possible advanced or applied topics for the time after the Strogatz texbook can be chosed from this list:

Stability and bifurcations in Engineering

Euler beam buckling as bifurcation

Nonlinear behavior of materials

Nonlinearity, chaos and complexity in Physics and Astrophysics

The three body and N-body systems

Orbits, Lagrange points, Lyapunov timescales in planetary and galactic systems

Nonlinear continuum mechanics

Dynamics of incompressible and compressible fluids

Vortices and turbulence in aerodynamics

Turbulent jets

Dynamics of galacic and protoplanetary disks

Linear and nonlinear stability and evolution

Nonlinear waves, Fluid resonances, Particle resonances

Nonlinear optics

Quantum chaos

Noise and corruption of signals in physical systems

- Noise: white, pink, black, non-power law
- Convolution, PSF