האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Advanced analytical mechanics - 77966

Last update 05-03-2019

HU Credits: 3

Degree/Cycle: 2nd degree (Master)

Responsible Department: Physics

Academic year: 0

Semester: 2nd Semester

Teaching Languages: Hebrew

Campus: E. Safra

Course/Module Coordinator: Dr. Ido Barth

Coordinator Email: ido.barth@mail.huji.ac.il

Coordinator Office Hours: By appointment

Teaching Staff:

Dr. Ido Barth

Course/Module description:
Advanced course in analytical mechanics

Course/Module aims:
1. To deepen the theoretical understanding of nonlinear multidimensional Hamiltonian systems.
2. To provide applicable knowledge in perturbation theories and in numerical methods for dynamical systems.

Learning outcomes - On successful completion of this module, students should be able to:
1. To analyze Hamilonian systems by the means of action-angle variables.
2. To identify symmetries, topology, constants of motion, and adiabatic invariants.
3. To use perturbation theories for solving stationary, dynamical, and resonant problems.
4. To write a symplectic scheme for numerical simulations of dynamical systems.

Attendance requirements(%):
0

Teaching arrangement and method of instruction: Lecture, exercise, and homework

Course/Module Content:
1. A review of the formalisms of Lagrange, Hamilton, and Hamilton-Jacobi.
2. Dynamics in phase space, Liouville theorem, and Poisson brackets.
3. The variational principle, canonical transformations, action-angle variables, adiabatic invariants, and phase space topology.
4. Integrability, Symmetry, and constants of motion.
5. Canonical perturbation theory, time dependent perturbation theory, averaging methods.
6. Nonlinear oscillator, nonlinear resonance, autoresonance, three wave interaction, and parametric resonance.
7. Chirikov resonance-overlap criterion, Arnold diffusion, nearly integrable systems, KAM theorem, Poincare map, Stochasticity, and chaos.
8. Symplectic schemes for numerical simulations of dynamical systems.

Required Reading:
non

Additional Reading Material:
• H. Goldstein, Classical mechanics, (Pearson 2013).
• L.D. Landau and E.M. Lifshitz, Mechanics, (Addison–Wesley 1960).
• A.J. Lichtenberg and M.A. Lieberman, Regular and stochastic motion, (Springer 1983).
• R.Z. Sagdeev, D.A. Usikov, and G.M. Zaslavsky, Nonlinear physics - from the pendulum to turbulence and chaos, (Harwood 1988).

Course/Module evaluation:
End of year written/oral examination 0 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 100 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:
non