

The Hebrew University of Jerusalem

Syllabus

Analytical Mechanics - 77303

Last update 11-08-2021

<u>HU Credits:</u> 6

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Physics

<u>Academic year:</u> 0

<u>Semester:</u> 1st Semester

<u>Teaching Languages:</u> Hebrew

<u>Campus:</u> E. Safra

Course/Module Coordinator: Dr Michael Moshe

Coordinator Email: michael.moshe@mail.huji.ac.il

Coordinator Office Hours: By appointment

Teaching Staff:

Dr. Michael Moshe, Mr. Linial Itai, Ms. Noemie Livne

<u>Course/Module description:</u> A course in analytical mechanics

<u>Course/Module aims:</u> See learning outcomes

Learning outcomes - On successful completion of this module, students should be able to:

Solve mechanics problems using Lagrangian and Hamiltonian formalisms.

<u>Attendance requirements(%):</u> 90

Teaching arrangement and method of instruction: Lecture and recitation, and weekly problem sets.

Course/Module Content:

The course will describe advanced analytical methods in mechanics developed in the 18th-19th centuries, namely the Lagrangian (action) formulation and the Hamiltonian (phase space) formulation. These methods supplement the Newtonian formulation both conceptually and in problem solving abilities. In addition they play a key role in 20th century physical theories including quantum mechanics and field theory.

Subjects within the Lagrangian formulation: Newtonian Mechanics, generalized coordinates, Lagrangian formulation, variational calculus, and the action; elementary examples for action level analysis; equilibrium points and small oscillations; symmetry and conservation laws (Noether's theorem); elimination of a cyclic coordinate at the level of the action; Legendre transform and Lagrange multipliers. The two-body problem. Perturbation theory.

Hamiltonian formulation: Hamiltonian and Hamilton's equations, phase space; symplectic structure and Poisson brackets. Hamilton-Jacoby equation and separation of variables.

Required Reading:

None

Additional Reading Material:

הקורס מבוסס על רשימות הקורס המבוססות בתורן על הספרים שבהמשך. חומרים מסוימים של
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- Classical Mechanics, H. Goldstein, C. Poole and J. Safko (2002)
- Mechanics, Landau & Lifshitz (1960)
- Analytical Mechanics, L. Hand and J. Finch (1998)
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<u>Course/Module evaluation:</u> End of year written/oral examination 87 % Presentation 0 % Participation in Tutorials 0 % Project work 0 % Assignments 13 % Reports 0 % Research project 0 % Quizzes 0 % Other 0 %

Additional information:

Grade consists of 13 points from weekly problem sets, and 87 points from final exam.

If morbidity condition would not allow an examination in campus, final exam format will be based on an online exam.