Classical Mechanics

Subject area: Physics

University:	L'X
Level:	BA2
Teaching mode:	hybrid: some students participate online, other students attend real-life
Instructor(s):	Jean-Marc ALLAIN

Short description

This course introduces students to the Lagrangian and Hamiltonian mechanics. Starting from the concepts of Newtonian mechanics, the course extends these concepts to a more systematic description of the mechanics, adapted to complex systems. The course mostly uses examples from the dynamics and vibrations of mechanical systems, with progressively increasing complexity. Examples from other fields of physics will be also proposed (electromagnetism, astrophysics, chaos…)

Full description

This course introduces students to the Lagrangian and Hamiltonian mechanics. Starting from the concepts of Newtonian mechanics, the course extends these concepts to a more systematic description of the mechanics, adapted to complex systems. The course mostly use examples from the dynamics and vibrations of mechanical systems, with progressively increasing complexity. Examples from other fields of physics will be also proposed (electromagnetism, astrophysics, chaos…)
After a reminder of the classical concepts of point mechanics, the course extends these concepts to the Lagrangian formalism and to the least action principle. The Lagrangian formalism will be used to describe the mechanics of rigid bodies. Lagrangian formalism will then be extended to the Hamiltonian mechanics which is at the core of quantum physics and other modern theories in physics. We will also present some extensions of Lagrangian and Hamiltonian mechanics to other fields of physics.
Upon completion of this course, students master equations and principles in analytical mechanics. They will be able to discuss the relevance of the chosen model, as well as derive and solve simple models taken from their environment.

Learning outcomes

Main concepts covered: Fundamental law of dynamics; kinetic and potential energy. Linearized equations of motion, dynamics of linear coupled oscillators.
Constraints and generalized coordinates, D'Alembert principle, Hamilton principle, Euler-Lagrange equations of motion, conservations of energy and momentum. Rigid body, center of mass, Euler angles, Moment of inertia and inertia tensor, Euler equation of motion.

Equations of Hamilton, conservation theorem.

General information

Contact hours per week:	3.5
Total workload:	49 hours + personal work (in student hours for the whole course)
ECTS credits:	5
Language:	English
Course start date:	19 September 2022
Course end date:	13 January 2023
Add. info about start date:	The course should start the week of September 19, 2022
Weekly teaching day/time:	Thursday Afternoon
Time zone:	CET (Denmark, Germany, France, Netherlands, Switzerland, Czech Republic)
Further information:	
Prerequisites:	Newtonian mechanic lecture / Mathematical methods for physics.
Activities and methods:	Lectures, Exercises, Tutorial sessions
Presence on campus:	none

Final examination

Form:	written
Date:	16 January 2023
Location/format:	TBC
Re-sit possibility:	
Transcript available:	end of semester and approx. 8 weeks after the exam's date
Add. info/requirements:	The exam will take place either the week of January 16, 2023 or the week of January 23, 2023

Registration

To register for this course, follow the registration requirements of your **home university** as specified here: www.euroteq.eu/courses-registration.

Administration

Number of places: 6

Minimum participants:

Internal course code: PHY201

Contact: exchange-international@polytechnique.fr

This course is part of the EuroTeQ Engineering University joint course catalogue 2022/2023. This is a collaborative activity of the partner universities DTU, L'X, TU/e, TalTech, CTU, TUM as well as Technion. Students from these universities can participate in the offered courses. It is the responsibility of the student to check if you fulfil the requirements to participate in a specific course. Students are also advised to check with their home institution how to get recognition of the ECTS credits gained in courses of the EuroTeQ course catalogue. For further information about EuroTeQ Engineering University, visit www.euroteq.eu or get in touch with the above-mentioned point of contact.