Universitat Autònoma de Barcelona

2019/2020

Classical Mechanics

Code: 100148
ECTS Credits: 10

Degree	Type	Year	Semester
2500097 Physics	OB	2	A

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: Yes

Teachers

José María Crespo Vicente
María del Pilar Casado Lechuga

Prerequisites

No prerequisits are needed but following recommendations may be useful.

It is very important to have a deep knowledge of basic concepts of Mechanics and Relativity from first year.

It is important to master basic tools of differential and integral calculus (one variable), approximations with taylor series and to know elementary integrals.

It is also recommended to know basic principles of calculus in several variables for Analytical Mechanics and matrix diagonalisation for coupled oscillators and inertia tensor.

Objectives and Contextualisation

General goals are :

1. Learning more advanced subjects in Classical Mechanics;

2. Being able to deal with approximations, mainly by means of Taylor series.

3. Knowing and applying Analytical Mechanics.

Specific goals are :

. Being able to solve physics systems with variable forces and masses.

. Resolving central forces problems using rotational symmetry.

. Dealing with particle systems and coupled oscillators.

. Studying rigid body rotations, inertia tensor and Euler equations.

. Advancing in Relativistic Dynamics.

. Knowing Lagragian and Hamiltonian formalisms.

Competences

- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Develop strategies for analysis, synthesis and communication that allow the concepts of physics to be transmitted in educational and dissemination-based contexts
- Formulate and address physical problems identifying the most relevant principles and using approximations, if necessary, to reach a solution that must be presented, specifying assumptions and approximations
- Know the fundamentals of the main areas of physics and understand them
- Respect the diversity and plurality of ideas, people and situations
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation

Learning Outcomes

1. Analytically and numerically solve the Newtons equation.
2. Describe conservative forces.
3. Describe motion in one, two and three dimensions.
4. Describe non-inertial reference systems.
5. Describe relativistic kinematics.
6. Describe shocks.
7. Describe the fundamentals of analytical mechanics.
8. Describe the fundamentals of classical mechanics.
9. Describe the kinematics and dynamics of rigid bodies.
10. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
11. Develop independent learning strategies.
12. Formulate and solve the motion of a system using Lagranges equations.
13. Identify laws of conservation in a system of particles.
14. Identify the concepts of linear and angular momentum and energy.
15. Properly handle the developments in Taylor series, the chain rule, implicit equations, diagonalization, dimensional analysis and vector calculus.
16. Respect diversity in ideas, people and situations.
17. Solve movement in the event of variable force or mass.
18. Solve the movement produced by a central force.
19. Translate specific physical problems to a mathematical formulation that allows subsequent resolution, either exact or approximate.
20. Transmit, orally and in written format, physical concepts of a certain complexity, making them understandable to non-specialist settings.
21. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments

Content

First Semester : Point-like mass Mechanics and Central Forces. Particle Systems.

Second Semester : Rigid bodies. Relativistic Dynamics. Introduction to Analytical Mechanics.

Methodology

There will be information in the Virtual Campus.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
magister lecture	55	2.2	3, 7, 8, 4, 6, 9, 5, 2, 10, 12, 14, 13, 17, 18
problem teaching	28	1.12	11, 10, 12, 15, 21, 17, 18, 16, 1, 19, 20
Type: Supervised			
Supervised tests	2	0.08	7, 8, 21, 18
Type: Autonomous			
Individual work	138	5.52	3, 7, 8, 4, 6, 9, 5, 2, 11, 10, 12, 14, 13, 15, 21, 17, 18, 16, 1, 19, 20
problem resolution	12	0.48	11, 10, 16, 20

Assessment

The qualification is 50% each semester. The semester qualification is equal parts for the two partials. Problem delivery can be 10% of qualification only in case of improvement.

The evaluation is successful if the student has attended all four partials, if the qualification is at least 5 and each semester at least 3.

If not successful or if successful but willing to improve students can do the final recovery examination. This final examination has two parts, one for each semester and the qualification of each part replaces the previous semester qualification only in case of improvement. The student can do both parts or only one. The qualifications of the final examination do not take in account problem delivery.

A student is evaluated if he/she has attended at least 35% of the qualification.

Students will be previously informed if a self-made formular is authorized in the examinations.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st partial 1st semester (recoverable)	22.5-25%	3	0.12	3, 8, 6, 2, 11, 10, 14, 13, 21, 1, 20
1st partial 2nd semester (recoverable)	22.5-25%	3	0.12	4, 9, 5, 11, 10, 21, 19, 20
2nd partial 1st semester (recoverable)	22.5-25%	3	0.12	6, 11, 10, 13, 15, 21, 17, 18, 1, 19, 20
2nd partial 2nd semester (recoverable)	22.5-25%	3	0.12	7, 11, 10, 12, 21, 19, 20

Problem delivery (recoverable in corresponding partial)	10%	0	0	11, 10, 21, 1, 19, 20
Recovery Examination (Optional if successful in partials)	100%	3	0.12	3, 7, 8, 4, 6, 9, 2, 11, 10, 12, 14, 13, 15, 21, 17, 18, 16, 1, 19, 20

Bibliography

J.B. Marion Classical Dynamics of Particles and Systems Academic Press New York and London

T.W.B. Kibble Classical Mechanics McGraw-Hill

A.F. Rañada Dinámica Clásica Ed. Alianza Universidad