COURSE DATA

Data Subject	
Code	34244
Name	Mechanics II
Cycle	Grade
ECTS Credits	7.5
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	2	Second term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	6 - Mechanics and waves	Obligatory

Coordination

Name	Department
BARENBOIM SZUCHMAN, GABRIELA ALEJANDRA	185 - Theoretical Physics
FABBRI, ALESSANDRO	185 - Theoretical Physics

SUMMARY

The course develops the key tools of advanced classical mechanics and relativity theory. We will cover fundamental results of Newtonian mechanics in greater depth, introduce the Lagrange and Hamiltonian formulations of mechanics, variational principles, Hamilton-Jacobi theory, and introductory notions of integrability and chaos. We will study in depth the theory of special relativity, including Einstein's equivalence principle, and its main physical implications.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Suggested prerequisite knowledge: General Physics, Calculus I and II, Differential equations, and Mechanics I. Students are encouraged to attend simultaneously the course: Oscillations and Waves.

OUTCOMES

1105 - Degree in Physics

- Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.
- To know how to apply the knowledge acquired to professional activity, to know how to solve problems and develop and defend arguments, relying on this knowledge.
- Developing learning skills so as to undertake further studies with a high degree of autonomy.
- Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .
- Be able to understand and master the use of the most commonly used mathematical and numerical methods.
- Modelización y resolución de problemas: Saber resolver problemas, siendo capaz de identificar los elementos esenciales de una situación y de realizar las aproximaciones requeridas con objeto de reducir los problemas a un nivel manejable.
- Destrezas Generales y Específicas de Lenguas extranjeras: Mejorar el dominio del inglés científico-técnico mediante la lectura y acceso a la bibliografía fundamental de la materia.
- Ser capaz de proseguir con el estudio de otras materias de la física gracias al bagaje adquirido en el contexto de esta materia.
- Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.
- Comprensión teórica de los fenómenos físicos: Conocer y comprender los fundamentos de la Mecánica clásica y de las ondas, así como del bagaje matemático para su formulación y de los fenómenos físicos involucrados y de las aplicaciones más relevantes.
- Cultura General en Física: Haberse familiarizado con las áreas más importantes de la mecánica en relación con la Física en general, y con enfoques que abarcan y relacionan diferentes áreas de la Física.

LEARNING OUTCOMES

The main aim of the course is to provide a strong background in advanced classical mechanics and relativity theory.

DESCRIPTION OF CONTENTS

1. Lagrangian and Hamiltonian Mechanics

Generalized coordinates. Constraints. Lagranges equations. Hamiltons variational principle. Charged particle in an electromagnetic field. Symmetries and conservation laws. Noethers theorem. Hamiltons equations. Phase space. Poisson brackets. Canonical transformations. Liouvilles theorem. Symmetries in phase space. The Hamilton-Jacobi formalism. Separation of variables. Action-angle variables. Completely integrable systems. Transition to chaos.

2. Relativity

The Michelson-Morley experiment. Einsteins two axioms of special relativity. Time dilation and length contraction. Simultaneity. Space-time diagrams. Lorentzs transformations. Velocity transformation rules. The Doppler effect and aberration. Relativistic momentum and energy. Equivalence mass-energy. The Minkowski space-time. 4-velocity and 4-momentum. Causality. Relativistic charged particle in an electromagnetic field. Collisions and decays of particles. Einsteins equivalence principle. Transition to general relativity.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	60,00	100
Tutorials	15,00	100
Development of individual work	30,00	0
Study and independent work	82,50	0
TOTAL	**187,50**	

TEACHING METHODOLOGY

We have four regular lectures per week , according to the timetable assigned by the Faculty of Physics. These lectures will cover the topics of the course. We will explain the general theory in class (together with illustrative examples). We leave detailed examples for the homework assignments. The homeworks are absolutely essential for understanding the course material. It is extremely important for students to work them out by themselves. Homework will be assigned once 1-2 weeks. The solutions to previous homework sets will be discussed in regular tutorial sessions (once a week, according to the official schedule).

EVALUATION

Grades will be based on a final exam (70%-100%) and the homework discussed in the tutorial sessions (0%-30%). The respective weights will be announced at the beginning of the course.

REFERENCES

Basic

- L. N. Hand y J. D. Finch, Analytical Mechanics, Cambridge University Press, 1998.
- C. Gignoux y B. Silvestre-Brac, Mécanique, EDP Sciencies, Université Joseph Fourier, Grenoble, 2002.
- D. W. Hogg, Special Relativity, http://cosmo.nyu.edu/hogg/sr/.

Additional

- J. V. José y E. J. Saletan, Classical Dynamics: a contemporary approach, Cambridge University Press, 1998
- T. W. B. Kibble y F. H. Berkshire, Classical Mechanics, Imperial College Press, 2004.
- J. R. Taylor, Classical Mechanics, University Sciencie Books, 2005.
- H. Goldstein, C. Poole y J. Safko, Classical Mechanics, Addison-Wesley Publishing Company, 2002.
- H. Müller-Kirsten, Classical Mechanics and Relativity, World Scientific Publishing Company, 2008.
- H. Iro, A Modern Approach to Classical Mechanics, World Scientific Publishing Company, 2002.
- I. Percival y D. Richards, Introduction to Dynamics, Cambridge University Press, 1982.
- Rañada, Dinámica Clásica, Alianza Universidad Textos, Madrid, 1994.
- G. L. Baker y J. P. Gollub, Chaotic Dynamics, Cambridge University Press, 1990
- C. Gignoux y B. Silvestre-Brac, Problèmes corrigés de Mécanique et résumés de cours, EDP Sciencies, Université Joseph Fourier, Grenoble, 2004.
- Lim Yung-kuo (Editor), Problems and Solutions on Mechanics, World Scientific Publiching Co. Pte. Ltd., 1994.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available

METODOLOGÍA DOCENTE

Durante el mes de febrero 2021, la docencia de teorías y seminarios-trabajos tutelados, pasan a modalidad de videoconferencia síncrona impartida en el horario fijado por la asignatura y el grupo.
A partir del 1 de marzo, se seguirá la modalidad docente indicada en la Guía Docente y en las modalidades docentes aprobadas en las Comisiones Académicas de Título de los meses de julio 2020 y noviembre de 2020, respectivamente, a menos que las autoridades sanitarias y Rectorado indiquen una nueva reducción de presencialidad, en este caso se volvería a la modalidad de videoconferencia síncrona.