Bachelor in Physics
(Academic Year 2025-26)

Physics Fundamentals I	Code	808251	Year	1st	Sem.	1st
Module	Basic Core	**Topic**	Physics	**Character**	Obligatory	

	Total	Theory	Exercises
ECTS Credits	9	4.5	4.5
Semester hours	84	39	45

Specific course contents
Newtonian dynamics. Systems of particles. Kinetic theory. Rigid body. Oscillations. Introduction to special relativity. Introduction to fluid mechanics. Elasticity and deformations.
Prerequisites
Physics and mathematics knowledge acquired in “Bachillerato”.

Coordinator	Carlos Díaz - Guerra Viejo		**Dept.**	FM
	Room	02.111.0	**e-mail**	cdiazgue@ucm.es

Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	7	Tu, Th, Fr	11:00 – 13:00	Carlos Díaz-Guerra Viejo	Complete semester	84	T/E	FM

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Carlos Díaz-Guerra Viejo	Mo,Tu: 14.30-16.00 +3h On line	*cdiazgue@ucm.es*	02.111.0

Syllabus

1. Introduction. Physical quantities and units of measurement. Scalar and vector quantities. Introduction to vector calculus. Coordinate systems. Estimations.

2. Kinematics. Speed and acceleration. Acceleration components. Relative translation motion: Galilean transformations.

3. Dynamics. Newton´s laws: inertial mass. Linear momentum and its conservation. Principle of relativity. Inertial forces. Angular momentum. Torque. Central forces. Force fields.

4. Work and Energy. Kinetic energy. Potential energy. Gradient. Conservative forces. Potential energy curves. Conservative and dissipative forces. Energy dissipation.

5. Motion of a System of Particles. Centre of mass of a system of particles. Linear momentum and angular momentum of a system of particles. Orbital angular momentum. Spin. Kinetic energy of a system of particles and its conservation.

6**. Rigid Bodies. Moment of inertia**. Rotation dynamics of a rigid body. Statics. Stress, strain and elastic moduli.

7. Kinetic Theory. Collisions of ideal gas molecules. Pressure. Molecular kinetic energy. Law of equipartition of energy. Molecular speeds and mean free path. Microscopic interpretation of temperature. Internal energy.

8. Special Theory of Relativity. The Michelson–Morley experiment. Lorentz´s transformation. Time dilation. Lorentz contraction. Simultaneity. Velocity transformation equations. Momentum. Relativistic energy.

9. Oscillatory Motion. Simple harmonic motion. Kinematics of a harmonic oscillatory movement. Force and energy. The simple pendulum. Superposition of harmonic movements. Damped oscillations. Forced oscillations. Resonance.

10. Fluids. Hydrostatics. Pressure in a fluid. Pascal´s principle. Archimedes' principle. Fluid Dynamics. Bernoulli's equation. Viscosity. Turbulent flow.

Bibliography

Basic

- M. Alonso and E. J. Finn, *Physics* (Pearson Education) [*Física* (Addison-Wesley Iberoamericana, 1995].
- Sears, Zemansky, Young and Freedman, *University Physics with Modern Physics, 13th Edition,* Pearson [*Física Universitaria* (12ª Ed., Pearson Educación, México 2009].
- R. A. Serway and J.W Jewett, *Physics for Scientists and Engineers* (Brooks/Cole, 9th Ed. (2014). [*Física***,** 1er vol., 4ª Ed. (McGraw-Hill, Madrid, 2001)].
- P. A. Tipler and G. Mosca, *Physics for Scientists and Engineers with Modern Physics*(Freeman, 6th Ed. (2007). [*Física para la ciencia y la tecnología***,** 1er vol., 6ª Ed. (Reverté, Barcelona, 2010)].

Complementary

- Feynman R.P., Leighton R.B. & Sands M., *Physics,* (Addison Wesley, 1987).
- F.A. González, *La física en problemas,* (Tébar, 2000).
- M. Lozano Leyva, *De Arquímedes a Einstein: los diez experimentos más bellos de la física*, (Debate, 2005).
- J.I. Mengual, M.P. Godino y M. Khayet, *Cuestiones y problemas de fundamentos de física*, (Ariel, Barcelona, 2004).

Online Resources

UCM Virtual Campus

Other resources:

- Catalogue of experiments for General Physics. http://www.ucm.es/centros/webs/oscar
- Interactive Physics Course, by Ángel Franco García. http://www.sc.ehu.es/sbweb/fisica_/
- MIT open course http:/ocw.mit.edu/OcwWeb/Physics/index.htm
- Caltech videos "The mechanical universe" http://www.acienciasgalilei.com/videos/video0.htm

Methodology

Teaching activities:

- Theory lessons. Main concepts will be explained and will be illustrated with examples and practical applications. (3 h/week).
- Practical lessons: exercises, case studies and other activities. (3 h/week).

Both blackboard and computer-aided classroom presentations will be used for theory lessons. Occasionally, theory lessons will be complemented with computer simulations or virtual exercises.

Students will be provided in due time and through the Virtual Campus with the list of exercises and problems that will be solved during the practical lessons.

Continuous assessment will be partially based on out-of-class works and exercises.

Evaluation Criteria

Exams — Weight: 75%

Midterm Exam: Yes Eliminatory: No Midterm weight: 30%

Final mark for the Exams section: $N_{Exam} = \max \{ N_{Final} , 0.3\, N_{Midterm} + 0.7\, N_{Final}\}$

where $N_{Midterm}$ is the mark obtained in the midterm exam and $_{NFinal}$ is the mark obtained in the final exam, both between 0 and 10.

Minimum mark in the final exam for weighting: $N_{Final} \geq 4.5$

The exams may be divided in one section containing theoretical–practical questions and another section containing problems (with a difficulty level similar to those solved in class).

According to the faculty board's agreement, at least 60% of the first-year midterm and final exams must be shared by all groups.

The exams will be the same for all groups.

Other Activities — Weight: 25%

Continuous assessment activities may include:

- Problems and exercises to be solved in group or individually.
- Short exams or tests (classroom)
- Online tests or questionnaires (Virtual Campus)

The final grade for this component will be $N_{OtherActiv}$ and will range from 0 to 10.

Final Mark

Final mark:

$$C_{Final} = \max \{ 0.75 N_{Exam} + 0.25 N_{OtherActiv} , \; N_{Exam} \}$$

The final mark criterion will be maintained in the exam of the extraordinary call.

Learning and Training Outcome (according to the Degree's Verification Document)

- CON01: Identify the physical, mathematical, experimental and computational basis of the different fields in Modern Physics.
- HD04: Develop models to describe physical phenomena through well-defined approximations.
- HD06: Apply critical thinking to problem analysis and resolution.
- HD08: Organize time and resources autonomously to acquire new knowledge.