UNIVERSIDAD CARLOS III DE MADRID - SCHOOL OF ENGINEERING - PHYSICS DEPARTMENT
PHYSICS I - 15075 - FALL 2025/2026
Bachelor in Robotics Engineering, Energy Engineering, and Electrical Power Engineering

Course Meeting	Section	Hour	Professor	Classroom
Lectures: 1 session/week	M 41, 42-59, 250	11:00 - 13:00 Monday	Fernando J. Gómez-Ruiz	1.0.F03 B. Betancur
Recitations: 1 session/week	250	11:00 - 13:00 Tuesday	Fernando J. Gómez-Ruiz	1.0.H03 B. Betancur
	42-59	11:00 - 13:00 Wednesday		2.3.C03 B. Sabatini
	41	11:00 - 13:00 Thursday		2.3.A04 B. Sabatini
Laboratory: 4 Practices	250	Group A: 17:00 - 19:00 [Sep. 29th, Oct. 13th, Nov. 10th, 24th]. Group B: 19:00 - 21:00 [Sep. 29th, Oct. 13th, Nov. 10th, 24th]		LAB. 4.S.B01
	42-59	Group A: 15:00 - 17:00 [Sep. 29th, Oct 13th, Nov. 10th, 24th]		
	41	Group A: 13:00 - 15:00 [Sep. 29th, Oct. 20th, Nov. 3rd, 17th]. Group B: 13:00 - 15:00 [Oct. 7th, 21th, Nov. 4th, 18th].		
Tutorial / Questions	M 41, 42-59, 250	Tuesday 15:00 – 16:30 [contact before fegomezr@fis.uc3m.es]		4.0.A01

Course Description and Objectives

This course aims to guide students in the appropriation of the scientific method and foster the development of critical and analytical skills for addressing both scientific and practical problems. The course provides an introduction to the fundamental principles of classical mechanics, covering topics such as translational and rotational dynamics of bodies, conservation laws, and the basics of thermodynamics.

Learning Objectives

By the end of the course, students are expected to develop the following competencies and skills:
-- Demonstrate knowledge and understanding of the fundamental concepts of mechanics and thermodynamics.
-- Apply mathematical tools to formulate and analyze physical models.
-- Employ the scientific method in the study and interpretation of physical phenomena.
-- Develop problem-solving skills relevant to physics.
-- Use scientific instruments effectively and analyze experimental data with rigor.
-- Retrieve, evaluate, and integrate information from diverse scientific sources.

Methodology:

The course will be delivered through theoretical lectures, where the main concepts of Classical Mechanics and Thermodynamics will be introduced and discussed. To maximize understanding and active participation, students are encouraged to read the recommended materials associated with each lecture in advance. This preparation will allow them to engage more effectively during class and to consolidate their learning through problem-solving and discussion.

Required Textbook:

University physics with modern physics
15th Edition, Hugh D. Young and Roger A. Freedman, published by Pearson Education © 2020
INGEBOOK PEARSON GLOBAL (UC3M Library)

Class	Date	Readings	Topics	Assignments
1	Sep. 8	Sec. 1.5 to 1.10 & Sec. 2.1 to 2.6 **Summary Pag. 53 & 84**	**Introduction. Kinematics of a particle I**. - Vectors position, velocity and acceleration. - Motion in 2 and 3 dimensions. Equation of trajectory. Projectile motion.	**Chapter 1:** 10, 39, 43, 55, 60, 66, 74, 91 **Chapter 2:** 10, 22, 23, 26, 36, 44, 70, 77, 84
2	Sep. 15	Sec. 3.1 to 3.5 **Summary Pag. 118**	**Kinematics of a particle II.** - Intrinsic components of acceleration (normal and tangential accelerations). - Circular motion. - Transformations among systems of reference. Relative motion.	**Chapter 3**: 19, 21, 25, 43, 47, 51, 62, 65, 67
3	Sep. 22	Sec. 4.1 to 4.6 & Sec. 8.1. **Summary Pag. 148**	**Dynamics of a particle I.** - Mass. Linear momentum. Force - Newton's laws. Equations of motion. - Examples of forces: weight, elastic force, tension, contact forces.	**Chapter 4**: 23, 24, 28, 36, 37, 38, 43, 54, 57
4	Sep. 29	Sec. 5.1 to 5.5. **Summary Pag. 184**	**Dynamics of a particle II.** - Forces in linear accelerated systems and circular motion. - Angular momentum. Moment of forces.	**Chapter 5**: 42, 46, 47, 58, 59, 60, 68, 72, 73, 89, 91, 92, 93, 94, 99, 100, 1003, 105, 119
			1-st Midterm EXAM 6%	
	Oct. 6	**Individual Work Week: Lectures and recitations will not be held**		
5	Oct. 13	Sec. 6.1 to 6.4 & Sec. 7.1 to 7.5. **Summary Pag. 218 & 252**	**Conservative and non-conservative forces. Work and energy**. - Work. Power. Kinetic energy. - Conservative forces and potential energy. - Non-conservative forces.	**Chapter 6**: 8, 10, 13, 17, 20, 41, 44, 52. **Chapter 7**: 39, 41, 47, 50, 55, 56, 63, 65, 70
6	Oct. 20	Sec. 8.2 to 8.6. & 11.2 **Summary Pag. 288**	**Systems of particles.** - Internal and external forces. - Kinetic energy of a system of particles. - Conservation theorems for a system of particles. - Motion of the Center of mass. - Collisions.	**Chapter 8**: 12, 24, 25, 28, 42, 43, 44, 73, 79, 82
7	Oct. 27	Sec. 9.1 to 9.6. **Summary Pag. 319**	**Kinematics of the Rigid Body.** - Motion of the Rigid Body in the plane. - Moment of Inertia. - Theorem of Steiner.	**Chapter 9:** 13, 15, 37, 47, 49, 68, 83, 84, 87, 90
8	Nov. 3	Sec. 10.1 to 10.7 & Sec. 11.1 & Sec. 11.3. **Summary Pag. 353 & 381**	**Dynamics of the Rigid Body.** - Angular momentum of the rigid body. - Plane motion equations. - Work of forces acting on a rigid body. Kinetic energy.	**Chapter 10**: 17, 20, 26, 27, 49, 50, 67, 70, 79, 95
			2-nd Midterm EXAM 6%	
9	Nov. 10	Sec. 17.1 to 17.6 **Summary Pag. 596**	**Introduction to Thermodynamics**. Temperature. - Thermodynamics: concepts and definitions. - Pressure. - Definition of temperature. Zeroth Law. - The Ideal-Gas Law.	**Chapter 17**: 5, 15, 18, 37, 39, 48, 50, 61, 68, 82
10	Nov. 17	Sec. 18.1 to 18.6. **Summary Pag. 630**	**Thermal properties of pure substances**. Heat. - Thermal coefficients: expansion and isotherm compressibility. - Heat. Heat capacities and specific heats. - Phase Diagrams. Phase Changes. Latent Heat.	**Chapter 18**: 7, 9, 24, 35, 37, 44, 65, 69, 73, 79
11	Nov. 24	Sec. 19.1 to 19.6. **Summary Pag. 660**	**First Law of Thermodynamics** - Work - Internal Energy. - First Law of Thermodynamics. - Application to ideal gases.	**Chapter 19**: 4, 11, 34, 39, 41, 46, 48
12	Dic. 1	Sec. 19.7 to 19.8 & Sec. 20.1 to 20.3 **Summary 697**	**Second Law of Thermodynamics I.** - Statement of Kelvin-Planck. Heat engines. - Statement of Clausius. Refrigerating machines. Irreversibility. Cycle of Carnot. Theorem of Carnot. Consequences. - Cycles with ideal gases. Entropy.	**Chapter 19**: 49, 52, 60. **Chapter 20**: 5, 11, 19, 20, 31, 40, 41, 46, 52, 53
13	Dec. 8		**Holiday**	
	Dec. 9			
	Dec. 10		**3-rd Midterm EXAM 6%**	
	Dec. 12			

Grades will be reported with one decimal place. (Minimum passing grade: 5.0/10.0)

Evaluation		
	18 %	The type and dates of these evaluations will be determined by the professor of each lecture section and communicated to students on the first day of class.
	7 %	Problem-Solving Section
	60 %	Final exam: Compulsory to get 3 of 10 in the exam to pass the course. 4 problems. Extraordinary exam, two options: 60%(exam)/40%(c.e. + lab.) or 100% (exam).
	15 %	Experimental Physics Laboratory I: Mandatory attendance. Four sessions – four reports (one week to deliver).