# Bachelor in Physics
## (Academic Year 2026-27)

| Physics Laboratory I | Code | 808258 | Year | 1st | Sem. | 2nd |
|---|---|---|---|---|---|---|
| **Module** | Basic Core | | **Character** | Obligatory | | |

| | Total | Theory | Laboratory |
|---|---|---|---|
| **ECTS Credits** | 6 | 1 | 5 |
| **Semester hours** | 66.5 | 12 | 54.5 |

| Specific course contents |
|---|
| General Physics Laboratory: Mechanics, Thermodynamics, Electromagnetism, Optics, and Structure of Matter. Nature and measurement of physical phenomena. Units. Data analysis and basic statistics. Estimation of uncertainties. |
| **Prerequisites** |
| General physics at the Baccalaureate level.<br>It is recommended to have completed the subject *Computer Lab*. |



| **Coordinator:** | Daniel Sánchez Parcerisa | | **Dept.** | EMFTEL |
|---|---|---|---|---|
| | **Room:** | 03.218.A | **E-mail** | dsparcerisa@ucm.es |
| | Laura Muñoz Muñoz | | **Dept.** | EMFTEL |
| | **Room:** | 03.229.0 | **E-mail** | lmuñoz@pdi.ucm.es |



| Theory – Schedule and Teaching Staff | | | | | No. of Sessions | 8 |
|---|---|---|---|---|---|---|
| **Group** | **Lecture Room** | **Day** | **Time** | **Professor (12 h)** | | **Dept.** |
| **B** | 7 | Fr (1) | 13:00-14:30 | Daniel Sánchez Parcerisa | | EMFTEL |

(1) There will be a total of 8 theory session throughout the year

| Office hours | | | | |
|---|---|---|---|---|
| **Group** | **Professor** | **Schedule** | **E-mail** | **Location** |
| **B** | Daniel Sánchez Parcerisa | M: 10:00 - 13:00<br>+3h online | dsparcerisa@ucm.es | 03.218.C |

| Laboratory Teaching Staff | | | |
|---|---|---|---|
| **Group** | **Data Analysis Laboratory – Professor (6h)** | **Dpt.** | **e-mail** |
| **LB** | Daniel Sánchez Parcerisa<br>Natalia Calvo Fernández | EMFTEL<br>FTA | dsparcerisa@ucm.es<br>nataliac@ucm.es |
| **Group** | **Laboratory - Professor** | **Dpt.** | **e-mail** |
| **LB** | Daniel Sánchez Parcerisa<br>Natalia Calvo Fernández<br>Pablo Zurita Gotor | EMFTEL<br>FTA<br>FTA | dsparcerisa@ucm.es<br>nataliac@ucm.es<br>pzurita@ucm.es |

| Data Analysis Laboratory- Schedule | | | | No. of sessions: | 6 |
|---|---|---|---|---|---|
| **Group** | **Day** | **Hours** | **Dates** | **Location** | |
| **LB** | Fr | 13:00 - 14:30 | 22/1, 5/2, 19/2, 26/2, 30/4, 7/5 | Computer Rooms A2 and A3 | |

| Laboratory Schedule | | | | No. of sessions: | 13 |
|---|---|---|---|---|---|
| **Group** | **Day** | **Hours** | **Location** | **Remarks** | |
| **LB** | Th | 15:00-18:30 | General Physics Laboratory basement Physics Faculty | Students should deliver a written report of the practices in approximately 50% of the assignments. In the rest of them, it will suffice to fill a form with the results and their analysis during the Lab session.<br>Part of each session will be devoted to small group discussions of the results obtained and reports delivered in the previous session.<br>If needed sessions will be organized to make for missed ones. | |

## Syllabus

It comprises a total of 8 sessions of 1.5 hours, grouped into five topics:

- **Data treatment.** Linear regression. Weighted mean. Linear interpolation. Preparation of reports.
- **Descriptive statistics:** Discrete and continuous data. Frequency. Accumulated frequency. Histograms
- **Random variable.** Concept. Probability density. Mean and variance, quartiles and percentiles.
- **Probability distributions**. Discrete and continuous distributions. Uniform distribution, Normal distribution, Student's t., chi-squared Estimation of parameters.

| Laboratory experiments (Indicative) | Sessions |
|---|---|
| **Introduction.** Data analysis. Units. Types of measures. Error and uncertainty. | 1 |
| **Experimental practices.** Sessions in the laboratory covering the following topics:<br>**Mechanics:** Simple pendulum. Torsion pendulum. Surface tension. Hooke's law. Density of liquids.<br>**Thermodynamics.** Mechanical equivalent of heat. Enthalpy of melting ice.<br>**Electricity and magnetism.** Wheatstone bridge. Characteristic curve of a lamp. Oscilloscope operation. Alternating current: RC circuit. Measurement of magnetic fields.<br>**Optics.** Determination of refractive indexes. Power of lenses.<br>**Structure of matter.** Measurement of the charge/mass ratio of the electron. | 10 |
| **Complementary activities.** Report seminars. Discussion of results. Make-up sessions. Demonstration experiments. Visits to research laboratories. | 2 |
| **Data analysis.** Linear regression. Histograms. Graphics Data analysis module, Quizzes. | 6 |

| | |
|---|---|
| (Computer classroom). Six sessions of 1.5 hours. | |

## Bibliography

**Basic**

*Class notes,* available on the web.
*Experimental Methods. An introduction to the analysis of Data*. L. Kirkup. J. Wiley & Sons. 1994.
*Probability & Statistics for Engineers and Scientists*. R. Walpole et al. Prentice Hall

**Complementary**

*Practical Physics. G.L. Squires. Ed. Cambridge University Press, 2001.*
*Curso y ejercicios de estadística*, Quesada, Isidoro & López. Ed. Alhambra. 1989.
*Estadística Básica para Estudiantes de Ciencias*, J. Gorgas, et al. (available online).

## Online Resources

The subject is registered in the Virtual Campus.
There is also a website at http://fisicas.ucm.es/lab-fis-gen
Extra links are available on the web site and virtual campus.

| | |
|---|---|
| https://www.phyphox.org | Physics experiments with mobile phones |
| https://www.ucm.es/theoscarlab | Videos and tutorials of Physics experiments |

## Methodology

The subject consists of theory classes, laboratory, and data analysis sessions.

The theory classes will consist of expositions of the instructor, with projection of slides and realization of exercises.

Guided experiences will be carried out, with a prior script, during laboratory sessions (3.5 hours each) or catch-up sessions. Throughout each lab practice, students will have a tutor who will introduce it and answer their questions. During the experiment, a form will be filled with the measurements and calculations made, and an analysis of these. Additionally, in approximately half of the cases, a written report will be delivered in the following session. The forms and reports will be corrected and evaluated by the teachers and discussed with the students during the laboratory sessions.

The "data analysis" sessions aim at students being able to use computing tools in their calculations and reports. They will be held in the Computer Room and consist of sessions of 1.5 hours each.

## Evaluation Criteria

| **Exams** | **Weight:** | 40% |
|---|---|---|

Midterm exam: no

Final mark for the Exams section: $N_{Exam} = N_{Final}$

where $N_{Final}$ is the mark obtained in the final exam.

Theoretical-practical exam at the end of the semester.

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

| **Other activities** | **Weight:** | 60% |
|---|---|---|

Laboratory and data analysis experiments. Online quizzes.

For each laboratory experiment, a report of the measures taken will be delivered. In approximately 50% of the cases, it will be a complete report, including a description of the method used, estimation of the associated uncertainties, and a discussion of the results obtained. In the rest of the cases, only the measurements and results will be presented, along with an analysis of the results.

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

## Final Mark

Final mark:

$$C_{Final} = 0.4N_{Exam} + 0.6N_{OtherActiv}$$

Minimum mark on the final exam for weighting: $N_{Final} \geq 4$

Minimum final mark on the other activities for weighting: $N_{OtherActiv} \geq 4$

To pass this subject, both in the ordinary and extraordinary examination periods, it will be mandatory to have completed all the lab sessions and delivered all reports and results on time and in the required form.

If needed, the marks of both activities will be kept for the extraordinary call, which will also offer the possibility of being evaluated of the exercises not performed during the course.

## 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.
- HD01: Knowing the experimental fundamentals used to describe physical phenomena and to check the validity of theoretical model.
- HD02: Apply experimental and computational techniques for the analysis and interpretation of physical phenomena.
- HD03: Evaluate the limits of experimental results due to the approximations performed and to neglected effects.
- HD06: Apply critical thinking to problem analysis and resolution.
- HD07: Produce projects and reports on topics of interest in Physics geared towards research or technological development, including team working when necessary
- HD08: Organize time and resources autonomously to acquire new knowledge.