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

| Calculus I | Code | 808252 | Year | 1st | Sem. | 1st |
|---|---|---|---|---|---|---|
| **Module** | Basic Core | | **Character** | Obligatory | | |

| | Total | Theory | Exercises/Prior knowledge |
|---|---|---|---|
| **ECTS Credits** | 9 | 4 | 5 |
| **Semester hours** | 84 | 29 | 43/12 |

| Specific course contents |
|---|
| Consolidation of prior knowledge in mathematics. Differential and integral calculus in one variable. Numerical and power series. Improper integrals. |
| **Prerequisites** |
| High-school Mathematics. |



| Coordinator | Víctor Martín Mayor | | Dept. | FT |
|---|---|---|---|---|
| | Room | 03.323.3 | e-mail | vicmarti@ucm.es |



| Theory/Problems – Schedule and Teaching Staff | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Group** | **Lecture Room** | **Day** | **Time** | **Professor** | **Period/ Dates** | **Hours** | **T/E** | **Dept.** |
| **B** | 7 | W,Th, Fr | 9:00 – 11:00 | Prado Martin Moruno | Full term | 84 | T/E | FT |

T: Theory, E: Exercises

| Office hours | | | | |
|---|---|---|---|---|
| **Group** | **Professor** | **Schedule** | **E-mail** | **Location** |
| **B** | Prado Martin Moruno | J:11:30-14:30 +3h online | pradomm@ucm.es | 03.314.0 |

## Syllabus

**1.- Review.** Sets. Mathematical language. Newton's binomial theorem. Real numbers. Inequalities.

**2.- Real functions.** One-one and onto functions. Review of the elementary functions: polynomial, exponential, logarithmic and trigonometric.

**3.- Infinite numerical sequences.** The concept of limit. Calculation of limits.

**4.- Limits and continuity of functions.** Theorems on continuous functions defined on intervals.

**5.- Definition and calculation of derivatives.** Differentiability of the elementary functions. The chain rule.

Theorems on differentiable functions.

**6.- Applications of the derivative.** Extrema. Graph of a function.

**7.- Infinite numerical series.** The geometric series and its sum. Convergence tests: the comparison test, the limit test, the Leibniz test, the ratio test, the radical test.

**8.- Power series.** The radius of convergence, operations with power series, differentiation. Taylor polynomials and Taylor series.

**9.- Calculation of limits.** Use of L'Hopital's rule and Taylor polynomials.

**10.- The concept of integral.** Definition. The fundamental theorem of Calculus.

**11.- Calculation of antiderivatives.** Partial integration. Antiderivatives of rational functions. Change of variables. Antiderivatives of trigonometric functions.

**12.- Improper integrals.** Unbounded integration interval or unbounded function. Convergence tests.

## Bibliography

**Basic:**

– Stewart, J, *Calculus: Early Transcendentals*, Brooks/Cole Pub Co, 1995.

– Boas, Mary L., *Mathematical Methods in the Physical Sciences*, John Wiley & Sons, 2006.

**Complementary:**

– Spivak, M., *Calculus*, Publish or Perish, 1980.

## Online Resources

Material and announcements related to the course will be posted in the UCM "Campus Virtual".

## Methodology

Review lectures will consist essentially of problem-solving sessions. In the ordinary lectures, half of the time will be spent on theoretical explanations (including examples) and the other half on problem solving sessions. The corresponding exercises will be made available to the students in advance.

Along the course, additional take-home exercises, quizzes or projects may be assigned. In addition, exercises or tests similar to those discussed in problem-solving sessions may be given during lecture hours and graded.

The instructor will answer both theoretical and problem-related questions from the students in his office during tutoring hours.
There will be a mid-term exam covering the first half part of the material, and a final exam at the end of the term. Examination questions and exercises will be similar to those explained in the lectures/problem-solving sessions. Older exams will be facilitated in advance to the student

## Evaluation Criteria

| **Exams** | **Weight:** | 70% |
|---|---|---|

Midterm Exam: Yes Eliminatory: No Midterm weight: 40%

Final mark for the Exams section: $N_{Exam} = \max \{ N_{Final} , 0.4\ N_{Midterm} + 0.6\ N_{Final}\}$

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

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

The mark for the extraordinary call will be determined using exactly the same assessment procedure.

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

60% of the questions will be common to all groups in both the midterm and the final exams.

| **Other Activities** | **Weight:** | 30% |
|---|---|---|

The instructor of each group will decide how to assess these Other Activities:

- problems or tests completed in class or at home, individually or in groups;
- attendance at classes;
- participation in other types of academic activities.

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

## Final Mark

Final mark:

$$C_{Final} = \max \{ 0.7N_{Exam} + 0.3N_{OtherActiv}, \ N_{Exam} \}$$

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

Minimum mark in the final Exam section for weighting: $N_{Exam} \geq 4.5$

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.
- HD05: Apply mathematical methods to problem solving in Physics
- HD06: Apply critical thinking to problem analysis and resolution.
- HD08: Organize time and resources autonomously to acquire new knowledge.