Bachelor in Physics
(Academic Year 2022-23)

Mathematics		Code	800492	Year	1st	Sem.	1st
Module	Basic Core	Topic	Mathematics			Character	Obligatory

	Total	Theory	Exercises
ECTS Credits	9	4	5
Semester hours	84	34	50

Learning Objectives (according to the Degree's Verification Document)

- Reinforce previous elementary mathematical concepts.
- Acquire the ability to analyze and calculate limits and derivatives.
- Know how to study real functions of a real variable and find their extrema.
- Know how to calculate definite and indefinite integrals of functions of a real variable.

Brief description of contents

Review of basic mathematical concepts, differential and integral calculus of functions of a real variable.

Prerequisites

High-school Mathematics.

Coordinator	María Jesús Rodríguez Plaza		Dept.	FT
	Room	03.0309.0	e-mail	mjrplaza@fis.ucm.es

Theory/Problems – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	7	We,Th Fr	9:00-11:00	María Jesús Rodríguez Plaza	Full term	84	T/E	FT

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	María Jesús Rodríguez Plaza	We, Th: 12.00-15.00	mjrplaza@fis.ucm.es	03.0309.0

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 of the material), as well as an end-of-term exam (covering the second half of the material). The final exam will be given in July. All the corresponding exercises will be similar to those explained in problem-solving sessions. Exercises given in recent exams will be posted in advance.

Evaluation Criteria		
Exams	**Weight:**	70%

There will be two midterm exams, P1 and P2, each of which graded from 0 to 10. These exams will consist of problems similar to those resolved in the lectures.

Students will pass the course directly if both P1 and P2 marks are greater or equal to 5, or if the arithmetic mean (P1+P2)/2 is ≥5 and the worst number of P1, P2 is larger than 4.5. In any of these two cases the grade of the student in exams, E from now on, will be (P1+P2)/2.

Those students who do not meet the previous criteria must take the final exam which will cover all the subject material. The grade of this exam, F, will be also a number between 0 and 10. The mark of these students in exams, E, will be equal to F.

Students who passed the course directly may want to improve their marks. They can take the final exam F for such purpose and the grade E in exams will be then the arithmetic mean of (P1+P2)/2 and F.

The same rule will apply to the extraordinary exams.

Other Activities		
	Weight:	30%

The lecturer of each group decides how to grade these Other Activities. Partial or full credits will be assigned to problems or tests solved individually or in groups in the classroom or as homework; or by regular lecture attendance and supervisions, or by any other academic activity that the professor may find of relevance.

The grade of these activities, denoted by A, will be a number between 0 and 10.

Final Mark

With E denoting the mark in exams and A denoting the final mark accounted in Other Activities, the final grade C_F of the student will be given provided that E≥4 by the formula

$$C\_F = \text{máx}(0.3*A + 0.7*E, E).$$

A student will pass the course if C_F ≥ 5.

If E<4 but C_F≥5, the final mark of the course will be E.

Extraordinary exams will follow the same rules.