Bachelor in Physics
(Academic Year 2024-25)

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 Cristina Martínez Pérez			Dept.	EMFTEL
	Room	03.229.0	e-mail	crismp@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	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: 10:30-12:30 Th: 12:30-14:30 Fr: 12:00-14:00	mjrplaza@fis.ucm.es	03.309.0

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%
A midterm exam will be held in the middle of the semester. It will eliminate material for those students who wish to do so, as long as they obtain a grade greater than or equal to 4.5 (out of 10).		

Those who obtain a grade lower than 4.5 in the midterm exam will have to take the entire subject in the final exam.

The final exam or Ordinary Final exam as it is also called will be mark from 0 to 10. A student with grade P >= 4.5 in the midterm exam has two options:

1) take the final exam on the material covered exclusively by the second part of the term. The score in exams E will be then the arithmetic mean (P+F)/2 where F is the mark obtained in the final exam.

2) take the final exam on the whole material of the course, then E=F.

Students who failed to obtain 4.5 in P will take the final exam with no reduction whatsoever in the material of the term and E=F.

The Extraordinary exam covers the entire taught material irrespective of the score obtained by the student in P.

In every exam of the course 60% of the questions/exercises is common to all groups.

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≥4.5 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<4.5 but C_F≥5, the final mark of the course will be E.

Extraordinary exams will follow the same rules.