Bachelor in Physics
(Academic Year 2021-22)

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

	Total	**Theory**	**Exercises**
ECTS Credits	9	4	5
Semester hours	83.5	33.5	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.

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Theory/Problems – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	3	We,Th Fr	9:00-11:00	Gabriel Álvarez Galindo	Full term	83.5	T/E	FT

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Gabriel Álvarez Galindo	Wed 15:00-18:00 + 3 h online	galvarez@ucm.es	Office12 (2nd West)

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:

- *Calculus* (4th edition), M. Spivak, Publish or Perish (2008).
- *Calculus* (10th edition), R. Larson, B. H. Edwards, Cengage Learning (2013).

Complementary:

- *Calculus-Vol. 1* (2nd edition), T. M. Apostol, Wiley India (2011).

Online Resources

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

Methodology

On-campus teaching 100% (Scenario 0)

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.

Semi-online teaching (Scenario 1)
The group B of Mathematics will apply the partially classroom-based modality A: * Partially classroom-based lectures on theory and problems, where the basic concepts of the subject will be explained and illustrated with examples and applications. The audio and the blackboard projection (whatever its type) will be broad-casted live via internet. * The students will be provided with practical worksheets before their solution at class. * There will be in-person tutorials if appropriate and always keeping the due health and safety measures. Alternatively, they will be via electronic mail, videos or syncronous streaming tools (Microsoft Teams, Google Meet, etc.). Online tutorials will conducted within the schedule established for them by the each professor.
Online teaching (Scenario 2)
The group B of Mathematics will consider the following guidelines for its non-classroom-based teaching: * Theory and practical lectures by means of videos posted on Virtual Campus or in live streaming during the class schedule. Videos will reamin available to the students therein. * Doubts and issues will be solved via electronic mail or online tuorials during the corresponding schedule. * Text and audiovisual material will be provided through the Virtual Campus to further support the lectures.

Evaluation Criteria		
Exams	**Weight:**	70%
The exercises in the mid-term and end-of-term exams will be similar to those discussed in problem-solving sessions. At least 60% of the exercises will be shared by all the groups. Each of these exams will be graded from 0 to 10. Students will pass the course if they get in these exams an average greater than or equal to 5 and a lowest grade greater than 4. Students not meeting the former criteria must take the final exam (covering all the material) to pass the course. Students meeting the former criteria can optionally take the final exam to get higher grades. Denoting by P1 and P2 the mid-term exam and end-of-term exam grades respectively, and by F the final exam grade (also from 0 to 10), the overall exam grade E will be given by the equation E=max((P1+P2)/2,F). The same rule will apply to the July make-up exam.		
Other Activities	**Weight:**	30%
In some groups, most of the credit for “Other Activities” will be given for problem-solving tests during lecture hours. In other groups, partial of total credit may be given to take-home exams or projects, regular class attendance or attendance to tutoring sessions. The overall grade for “Other Activities”, denoted by A, will range from 0 to 10.		
Final Mark		
Being E the final exam mark and A the overall grade for “other activities”, if $E \geq 4$ the final grade of the subject will be given by the formula: $C_F = \max(0.3*A + 0.7*E, \mathrm{E})$ [If $E<4$ and $C_F \geq 5$, the final grade will be 4.5]. The final grade in July will be computed according to this same formula.		