COURSE DATA

Data Subject	
Code	34238
Name	Calculus I
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	1	First term
1929 - D.D. in Physics-Chemistry	Double Degree Program Physics and Chemistry	1	First term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	2 - Mathematics	Basic Training
1929 - D.D. in Physics-Chemistry	1 - Primer Curso (Obligatorio)	Obligatory

Coordination

Name	Department
SANCHEZ ROYO, JUAN FRANCISCO	175 - Applied Physics and Electromagnetism
VICENTE MONTESINOS, AVELINO	185 - Theoretical Physics

SUMMARY

Mathematics is the language of physics, so a previous requisite in Physics studies is to learn the corresponding "Grammar" . With this idea in mind, the aim of the course is to familiarize the student with the part of the language related to differential and integral calculus involving single variable real functions and also an introduction to multivariable real functions.

Within the first year of the Physics degree the subject "Calculus I" provides mathematical tools used in the subject "Physics". Additionaly , the concepts developed in this calculus course are useful in almost all other subjects through the degree.

Topics in the curriculum (corresponding to Calculus I and II):

Elementary single variable functions , limits and continuity, differentiation, numerical and power series, taylor series, integration, multivariable functions, limits and continuity, line and surface integrals, Gauss's and Stokes's theorems.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Students taking the course should have basic knowledge in elementary single variable calculus. That is, they should be familiar with the concepts of derivative and integral and its use and applications to elementary functions. It would also be desirable a basic physical prior knowledge.
So, basically, in order to follow this course, students should have previously studied mathematics and physics at a high school level.

OUTCOMES

1105 - Degree in Physics

- To know how to apply the knowledge acquired to professional activity, to know how to solve problems and develop and defend arguments, relying on this knowledge.
- Be able to understand and master the use of the most commonly used mathematical and numerical methods.
- Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.
- Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.
- Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.
- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

-Understand the concepts of limit, derivative, integral, sequence and series. Become familiar with the differential and integral calculus for real functions.

-Calculate derivatives of functions of one and several variables using derivation rules. To be able to obtain Taylor expansions of single variable functions.

-Use the usual techniques for the integration of single variable functions (substitution, integration by parts, rational functions, trigonometric and hyperbolic functions, irrational, Barrow's rule, improper integrals, etc).

-Use software to calculate derivatives and integrals.

DESCRIPTION OF CONTENTS

1. Functions, limits and continuity.

Functions of real variable. Graphs. Limits and continuity of single variable functions. Types of discontinuity.

2. Derivatives.

Differentiation of single variable functions. Geometric interpretation. Calculation of derivatives. Chain rule. Higher-order derivatives. Rolle's and mean value theorems. LHôpitals rule. Extremes of a function.

3. Integrals of functions of one variable

Integration of single variable functions. Integration methods and primitives calculation. Riemanns integral. Applications. Improper integrals.

4. Sequences and series

Sequences of real numbers. Limits of sequences. Numerical series. Series of positive terms and convergence criteria. Alternating series. Absolute and conditional convergence. Sum of series. Power Series. Taylors series.

5. Introduction to differential Calculus in several variables.

Functions of various variables. Graphic representation. Topology elements in Rn. Limits and continuity of functions of various variables. Partial derivatives. Jacobian matrix and gradient. Differentiability of functions of various variables.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	45,00	100
Tutorials	15,00	100
Development of individual work	5,00	0
Study and independent work	75,00	0
Preparation of evaluation activities	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Direct Instruction (40%):

Lectures (Theory and problems) will cover the basic theoretical concepts and the techniques to tackle problems which will be developed through illustrative examples. These lectures will make use of tools like presentation projections, graphical solutions, calculation software, etc.

Practical problem-solving classes in small groups: focused on the student’s work and its active participation, providing a better understanding of basic concepts and problem solving strategies, reinforcing the more difficult ones, and following the student progress , associated with a component of continuous assessment.

Student's personal work (60%):

- Study of the theoretical basis.

- Resolution of problems (individual or in group).

- Individual tutorials: Students ask questions to the lecturers regarding doubts and difficulties encountered while studying and solving problems.

EVALUATION

The evaluation system is as following:

1) Written exams: They will evaluate the comprehension of the theoretical-conceptual aspects, the formalism of the subject and the ability to apply the formalism, through the resolution of exercises and/or questions. In the exam both the reasoning and resolution of the exercises will be assessed.

2) Continuous evaluation: it will depend on works and problems presented by the students, questions proposed and discussed in the classroom, oral presentation of solved problems or any other method that involves an interaction between teachers and students. The continuous evaluation will involve up to 30% of the final mark, as long as the written exam grade and the continuous evaluation does not differ by more than 3 points. The continuous evaluation grade can never reduce the exam mark. To pass the subject it is necessary to obtain a 5 out of 10.

OBSERVATIONS: As long as the compensation criteria established for this purpose are met, the mark of this subject may be averaged with others of the same subject in order to overcome it.

REFERENCES

Basic

- MATHEMATICAL METHODS FOR PHYSICS AND ENGINEERING: A COMPREHENSIVE GUIDE, K.F. Riley, M.P. Hobson y S.J. Bence, Cambridge University Press (2004)
- CALCULUS (3 vol.) , J. E. Marsden, A. Weinstein Springer-Verlag. I,1966-199
- CÁLCULO. UNA VARIABLE, G. B. Thomas, Pearson/Addison Wesley, 12ª Edición, 2010.
- CÁLCULO. VARIAS VARIABLES, G. B. Thomas, Pearson/Addison Wesley,12ª Edición, 2010.
- CALCULO SUPERIOR, M.R. Spiegel, Schaum McGraw-Hill (1969)

Additional

- CÁLCULO INFINITESIMAL DE VARIAS VARIABLES, J. de Burgos, McGraw Hill (1995)
- CALCULUS. UNA Y VARIAS VARIABLES, Vol. I y II. S.L. Salas, E. Hille, G.J. Etgen, 4ª edición, Reverté, 2002.
- CALCULO SUPERIOR, M.R. Spiegel, Schaum McGraw-Hill (1969)
- PROBLEMAS Y EJERCICIOS DE ANÁLISIS MATEMÁTICO, B. Demidovich, Paraninfo (1982)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

TEACHING METHODOLOGY:

In case that health situation requires blended teaching, the teaching model approved by the Academic Degree Committee on July 23, 2020 will be adopted, consisting of 100% student attendance in all activities, with 50% capacity in classrooms for lectures.

If a total reduction in attendance is necessary, classes will be broadcast by synchronous videoconference at their regular schedule, along the period determined by the Health Authority.