COURSE DATA

Data Subject	
Code	34248
Name	Mathematical methods II
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	2	Second term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	8 - Mathematical methods	Obligatory

Coordination

Name	Department
LLEDO BARRENA, M. ANTONIA	185 - Theoretical Physics

SUMMARY

- Objectives: To acquire the knowledge of complex variable necessary for the degree Physics
- Relationship with previous, current and future courses: Because the subject is instrumental, all the other courses of the degree in Physics may require the concepts and techniques
developed in this course. It is advisable to have passed the Mathematics courses (Algebra and Geometry I and II, Calculus I and II).
- Descriptors: Complex Numbers and Functions of complex variable. Differentiation, integration and series. Applications to the calculation of certain integrals. Integral transforms. Laplace and Fourier Transforms.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

It is essential to have already a good understanding of the objectives included in the Mathematics courses of the first year (Algebra and Geometry I and II, and Calculus I and II), namely
1. Differential calculus in one and several variables.
2. Integration in one variable and multiple integrals.
3. Real, numerical sequences and series
4. Power series
5. Linear systems
6. Vector Spaces
7. Matrices and determinants, linear operators, eigenvalues and eigenvectors.

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.
- Capacity to communicate information, ideas, problems and solutions to a specialist and a general audience.
- Developing learning skills so as to undertake further studies with a high degree of autonomy.
- Destrezas Generales y Específicas de Lenguas extranjeras: Mejorar el dominio del inglés científico-técnico mediante la lectura y acceso a la bibliografía fundamental de la materia.
- Modelización y resolución de problemas: Saber resolver problemas, siendo capaz de identificar los elementos esenciales de una situación y de realizar las aproximaciones requeridas con objeto de reducir los problemas a un nivel manejable.
- Ser capaz de proseguir con el estudio de otras materias de la física gracias al bagaje adquirido en el contexto de esta materia.
- 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.
- Destrezas matemáticas: comprender y dominar el uso de los métodos matemáticos y numéricos más comúnmente utilizados para la resolución de problemas en el contexto de la mecánica.

LEARNING OUTCOMES

1. To be able to perform computations with complex numbers. To know the characteristics of complex variable functions and the conditions of analyticity.
2. To understand the residue theorem and its applications to the calculation of integrals and series.
3. To be able to compute the Fourier or Laplace transform of a function and the inverse transforms.
4. To be able to construct a Fourier series

DESCRIPTION OF CONTENTS

1. 1. Complex numbers and complex functions.

Representation and operations with complex numbers. Curves C. The point of infinity. Functions of a complex variable. Differentiability and analyticity. Cauchy-Riemann conditions. Multivalued functions. Branch cuts, singularities and zeros. Power and logarithm function. Exponential trigonometric functions, hyperbolic functions

2. Integrals in the complex plane. Cauchy Theorem.

Integrals in the complex plane. Primitives. Cauchy theorem. Cauchy integral formula. High derivatives of a regular function.

3. Series in the complex plane. Residue theorem.

Numerical and functional series in the complex plane. Power series: Taylor and Laurent. Singularities. Classification. Residue theorem. Calculating residues. Examples.

4. Applications

Real improper integrals. Integration of single-valued functions. Poles in the way of integration. Examples. Integration of multiple-valued functions. Sum of series. The Gamma function. Properties.

5. Integral Transforms: Laplace and Fourier

The concept of integral transform. The Laplace transform and its properties. Inverse transform. Convolution. Heaviside function and Dirac delta. Operating Rules. Application to the resolution of differential equations. Fourier series. Dirichlet conditions. Fourier coefficients. Theorem of Parseval. Fourier transform and properties. Convolution and Fourier transforms.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	45,00	100
Tutorials	15,00	100
Development of individual work	30,00	0
Study and independent work	60,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The methodology of the course will be the following: 3 of the four weekly hours would correspond to theoretical and practical classes and 1 hour to tutoring classes for small groups.
In theoretical and practical classes the professor will develop the contents with emphasis on the resolution of questions, problems and applications. Some demonstration and / or application may be left as work for tutorials.
Tutoring classes will be devoted to solve and / or discussing the problems that the professor will make available to the students previously, in paper or via the virtual classroom. They will corrrespond to each chapter of the syllabus explained in theoretical and practical classes. Also, theoretical issues can be assigned to the to students, who would present the results to the class. The presentations will be assesed.
In general, each set of problems will contain `model' problems, which will be solved in the theoretical and practical class and others that will be solved by students. All the doubts and part of the problems assigned to students will be solved in tutorials.

EVALUATION

The evaluation of the subject will take into account both the work done in the supervised work sessions and the grade obtained in the exam:

Exam. It will have a weight that will be between 70% and 100% of the final grade (as explained below). An exam will be taken at the end of the semester. The exam will consist of a written test, which may consist on a first part of multiple choice questions and / or short theoretical questions, and a second part of problems. Each part will compensate with the other provided that a grade equal to or greater than 3.5 points out of 10 is obtained, and the weight of each of the parts is 50% of the exam grade.

Practical solving problems groups. They will weigh between 20% and 30% of the value of the final grade. The grade will reflect the work carried out and presented by the student in the work sessions. In order to obtain a grade on practical solving problems sessions, continued assistance to group sessions is necessary.

Final grade. The grades of the subject will be obtained from the corresponding exam and supervised works marks, in the following way *:

Final grade = 0.8 * E + 0.2 * T (Group A)

Final grade = max (0.7 * E + 0.3 * T, E) (Group B)

where E is the grade of the exam and T is the grade of supervised works, both over 10.

Notice that the exam (E) must always be equal to or greater than 3.5 (out of 10) in order to be able to compensate with the supervised work to obtain a passing grade (≥ 5).

Further:

The grade of this subject can be averaged with that of the Mathematical Methods I, so that both are passed if the average is equal to or greater than 5 points out of 10 and the grade minimum of any of them is 4 points over 10.

* The difference between the procedures to obtain the final grade between the two groups is due to the different group work techniques used.

REFERENCES

Basic

- J. Peñarrocha, A. Santamaría, J. Vidal, Mètodes Matemàtics: Variable Complexa. Universitat de València.
- K.F. Riley, M.P. Hobson, S.J. Bence, Mathematical methods for physics and engineering: A comprehensive guide, Cambridge University Press

Additional

- Ruel V. Churchill, James W. Brown, ``Variable Compleja y Aplicaciones''. MacGraw-Hill.
- J.E. Marsden, ``Basic Complex Analysis''. W. H. Freeman and Company.
- William R. Derrick, ``Complex Analysis and Applications''. Wadsworth International Group.

ADDENDUM COVID-19

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

1. Contenidos

En el bloque final de la asignatura (Aplicaciones y Transformadas integrales) se reducen los contenidos inicialmente recogidos en la guía docente seleccionando los conceptos indispensables para adquirir las competencias.

2. Volumen de trabajo y planificación temporal de la docencia

Llas clases teóricas se han sustituido por (i) aprendizaje autónomo del estudiante con los materiales subidos al aula virtual; (ii) sesiones de videoconferencia para explicar los conceptos principales y atender dudas.

3. Metodología docente

- Subida de material docente al aula virtual para aprendizaje autónomo (apuntes, presentaciones locutadas, ...);

- Videoconferencia síncrona mediante creación de tareas “Videoconferencia” en el aula virtual y ejecución de estas por Blackboard Collaborate. Subida al aula virtual de los materiales para estas sesiones (transparencias).

- Se responden dudas por email y en las sesiones de videoconferencia;

- Suministro de problemas resueltos junto a problemas propuestos a entregar mediante la opción de “Tarea” del aula virtual

4. Evaluación

- Incremento del peso de la evaluación continua a un 50%. La evaluación se basará en la resolución de problemas, la participación en las distintas actividades docentes y las notas resultantes de la evaluación continua obtenidas antes de la entrada en vigor del estado de alarma.

- Reducción del peso del examen final a un 50%.

El examen se subirá al aula virtual como Tarea, Cuestionario o similar en la fecha y hora previstas en el calendario académico. Cada estudiante deberá subir la resolución al aula virtua. Será la hora que figure en la actividad correspondiente del aula virtual como hora de entrega la que se tenga en cuenta para entender que se ha entregado en plazo. Los estudiantes deberán estar conectados mediante videoconferencia BBC con la cámara activada y el micrófono silenciado. Si una persona no dispone de los medios para establecer esta conexión y acceder al aula virtual, deberá contactar con el profesorado por correo electrónico en el momento de publicación de este anexo a la guía docente. Para aprobar la asignatura será necesario tener al menos un 3 en el examen final.

Si se considera necesario, se puede acordar una revision, o pre-revision, con el alumno un día distinto para aclarar algún punto del examen o de los ejercicios entregados.

5. Bibliografía

Los materiales necesarios (apuntes, transparencias, ejercicios) están accesibles en el aula virtual.