COURSE GUIDE

Mathematical Methods 2

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Matemática Aplicada: 14/06/2021
Física Atómica, Molecular y Nuclear: 14/06/2021
Análisis Matemático: 14/06/2021

Grado (Bachelor's Degree)	Bachelor's Degree in Mathematics + Bachelor's Degree in Physics	**Branch**	Sciences
Module	Métodos Matemáticos y Programación	**Subject**	Métodos Matemáticos

Year of study	2º	**Semester**	1º	**ECTS Credits**	6	**Course type**	Compulsory course

PREREQUISITES AND RECOMMENDATIONS

It is recommended that the student has taken the following subjects: Linear Algebra and Geometry, Mathematical Analysis and Mathematical Methods for Physics I.

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

Methods to solve ordinary differential equations and systems.

Partial differential equations. The method of separation of variables. Special functions

SKILLS

GENERAL SKILLS

- CG01 - Capacidad de análisis y síntesis
- CG02 - Capacidad de organización y planificación
- CG03 - Comunicación oral y/o escrita
- CG05 - Capacidad de gestión de la información
- CG06 - Resolución de problemas
- CG07 - Trabajo en equipo
- CG08 - Razonamiento crítico
- CG09 - Aprendizaje autónomo
- CG10 - Creatividad
- CG11 - Iniciativa y espíritu emprendedor

SUBJECT-SPECIFIC SKILLS

- CE03 - Comprender y conocer los métodos matemáticos para describir los fenómenos físicos.
- CE05 - Modelar fenómenos complejos, trasladando un problema físico al lenguaje matemático.

LEARNING OUTCOMES

- To know the fundamental results of the theory of Differential Equations.
- To know some of the applications of the ordinary differential equations in different fields in Physics, especially in Classical Mechanics, Electromagnetism and Quantum Physics.
- To understand how special functions arise in the study of ordinary differential equations and understand how to apply them.
- To know the fundamental results of the theory of Partial Differential Equations.
- To know some applications of the theory of Partial Differential Equations the in different fields in Physics, especially in Classical Mechanics, Electromagnetism and Quantum Physics.

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

Differential equations

- Lesson 1. Ordinary differential equations of first order. Methods of integration.
- Lesson 2. Ordinary differential equations of higher order. Lineal equations.
- Lesson 3. Solving differential equations by power series.

Special functions

- Lesson 4. Basic special functions.
- Lesson 5. Hypergeometric and Bessel functions.

Partial differential equations

- Lesson 6. Classical partial differential equations of interest in physics: The method of

separation of variables.

- Lesson 7: The wave equation, the heat equation and the Laplace equation.
- Lesson 8. Introduction to the Sturm-Liouville problem.

PRACTICAL SYLLABUS

Seminars:

1. Kepler's laws.
2. The Laplace transform.
3. Sturm's theory of separation of zeros.
4. The wave equation in two and three dimensions. Huygens principle.
5. Green's functions.
6. Euler's equations of fluids.
7. The multidimensional Schrödinger equation. Application to the infinite square well.
8. The multidimensional Schrödinger equation. Application to the three-dimensional harmonic oscillator.
9. The vibrating equation in two dimensions.

RECOMMENDED READING

ESSENTIAL READING

- M. Abramowitz, I. A. Stegun, Handbook of mathematical functions, Dover, 1975.
- L. C. Andrews, Special functions of mathematics for engineers, Oxford Science Publications, 1998.
- W.E. Boyce, R.C. DiPrima, Elementary differential equations and boundary value problems, Wiley 2012.
- L. C. Evans, Partial Differential Equations, AMS, 2002.
- V. Nikiforov, V. Uvarov, Special functions of mathematical physics (Birkhäuser Verlag, 1988).
- C. Henry Edwards, David E. Penney, David T. Calvis, Differential Equations and Boundary Value Problems: Computing and Modeling, Pearson Education 2015.
- C. Henry Edwards, David E. Penney, David Calvis, Differential Equations and Linear Algebra, Pearson 2017.
- E. Rainville, Intermediate Differential Equations, MacMillan, 1964.
- G.F. Simmons, Ecuaciones diferenciales con aplicaciones y notas históricas. McGraw Hill,

1993.

- W. A. Strauss, Partial differential equations, an introduction, New York, John Wiley and Sons, 2008.
- D.G. Zill, M.R. Cullen, Differential Equations with Boundary-Value Problems, Cengage Learning, 2009.

COMPLEMENTARY READING

- F. Brauer y Nohel, Ordinary Differential Equations with Applications, Harper & Row, 1989.
- C. Carlson, Special Functions of Applied Mathematics, Academic Press.
- R. K. Nagle, E. B. Saff y A.D. Snider, Ecuaciones diferenciales y problemas con valores en la frontera, Pearson Educación, 2005.
- F.W. Olver, Asymptotic and Special functions, Academic Press, 1974.
- R.D. Richtmyer, Principles of Advanced Mathematical Physics, vol. 1, Springer-Verlag, 1978.

RECOMMENDED LEARNING RESOURCES/TOOLS

Notes by Prof. R. Ortega "Métodos Matemáticos de la Física IV":
http://www.ugr.es/~rortega/M4.htm

Notes by Prof. M. Calixto "Métodos Matemáticos de la Física II":
https://www.ugr.es/~calixto/MMII.pdf

TEACHING METHODS

- MD01 Lección magistral/expositiva
- MD03 Resolución de problemas
- MD07 Seminarios y/o exposición de trabajos
- MD09 Análisis de fuentes y documentos

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

In order to evaluate the knowledge and competences acquired by the students, the following criteria will be used with the indicated percentages:

- Written examination including basic questions and problems/exercises. This will count 70% of the total score.
- Homework and seminars done individually or in groups. This covers all work and seminars made by the students during the curse (exercises and solving proposed problems). Importance will be given to the work itself, the slides presentation and the defense. Participation, aptitude and personal work in all programmed activities will be considered. The final score for this part will count up to 30%.

The final score will be a number resulting from the sum of the weighted scores from the different aspects integrated in the evaluation system.

In general, the attendance to lectures is not compulsory without being an impediment to apply the evaluation criteria described above.

EXTRAORDINARY EXAMINATION DIET

Regarding the extraordinary examination, this will be in written form and will consist of questions and problems/exercises to guarantee that the student can get the total score from it (100%), as it is established in the regulation of evaluation of students at the University of Granada, published in the official bulletin of the university number 112. 9 November 2016.

SINGLE FINAL ASSESSMENT (evaluación única final)

Besides the above-mentioned evaluation procedure, the students will be allowed to apply for a unique evaluation in the terms established in the regulation of evaluation of students at the University of Granada, approved on May the 20th of 2013.

The test consists of a written examination that includes theory and problems on the list of topics of the curse, similar to the extraordinary assessment sesion, where the student can get the total score from it (100%).

ADDITIONAL INFORMATION

All regarding evaluation will be applied according to the "Normativa de evaluación y calificación de los estudiantes" existing at the University of Granada, which can be found at:

http://www.ugr.es/~minpet/pages/enpdf/normativaevaluacionycalificacion.pdf