



Bachelor in Physics

(Academic Year 2026-27)

Mathematical Methods II			Code	800505	Year	2nd	Sem.	2nd
Module	General Core	Topic	Mathematical Methods in Physics		Character		Obligatory	

	Total	Theory	Exercises
ECTS Credits	6	3.5	2.5
Semester hours	55	30	25

Learning Objectives (according to the Degree's Verification Document)
- To use basic partial differential equations in Physics, to know their scope and to dominate fundamental techniques to obtain solutions. - To learn Fourier analysis methods and its applications to differential equations. - To get knowledge of most of the special functions used in Physics and their physical properties.
Brief description of contents
Partial differential equations. Fourier series and transformations. Boundary problem resolution. Special functions.
Prerequisites
Calculus on one and various variables functions. Linear ordinary differential equations.

Coordinator	Federico Finkel Morgenstern			Dept.	FT
	Room	02.311.0	e-mail	ffinkel@ucm.es	

Theory/Problems – Schedule and Teaching Staff								
Group	Lecture Room	Day	Time	Professor	Period/Dates	Hours	T/E	Dept.
B	19	Mo Th	12:00 – 14:00 10:00 – 12:00	Carmelo Pérez Martín	Fulm term	55	T/E	FT

T: Theory, E: Exercises

Office hours				
Group	Professor	Schedule	E-mail	Location
B	Carmelo Pérez Martín	Mo, We: 15:00-18:00	carmelop@fis.ucm.es	03.0316.0

Syllabus
1. Introduction to partial differential equations (PDEs). First order PDEs. Second order linear PDEs. Boundary and initial value problems. The equations of Mathematical-Physics. The wave equation. 2. Series solutions for second order linear ODEs and special functions. Regular point and regular singular points. Hermite, Legendre and Bessel equations. 3. Boundary value problems for ODE. Fourier series and Fourier transform. Eigenvalues and eigenfunctions. Sets of orthogonal functions. Eigenfunction series expansions. Fourier trigonometric series. Convergence. Inhomogeneous problems. Fourier transforms. 4. EDP: method of separation of variables and eigenfunction expansion method. Homogeneous and non-homogeneous problems for the equations of Mathematical Physics (heat, wave, Laplace, Schrödinger, ...). Cartesian, polar, cylindrical and spherical coordinate problems.

Bibliography
Basic: - Partial Differential Equations: An Introduction, Walter A. Strauss. John Wiley & Sons - Introduction to Partial Differential Equations, Peter Olver. Springer 2016. <i>Applied Partial Differential Equations with Fourier Series and Boundary Value Problems</i>. Richard Haberman. Pearson Education Limited (2013). <i>Boyce's Elementary Differential Equations and Boundary Value</i>. William E. Boyce, Richard C. DiPrima, Douglas B. Meade. John Wiley & Sons Inc (2017). Complementary: <i>Partial Differential Equations</i>, Peter J. Olver, Springer <i>Fourier Series</i>. Georgi Tolstov. Dover <i>Ecuaciones Diferenciales II</i>. Manuel Mañas Baena y Luis Martínez Alonso.(http://eprints.ucm.es/31464/1/Manuel.pdf)

Online Resources
We will use the UCM's Moodle facility (Campus Virtual)

Methodology
We will follow the material uploaded to the Moodle platform. In particular, The professor lecture notes. The classes will be divided in theoretical and practical, solving in these last ones' exercises from the professor lecture notes.

Evaluation Criteria		
Exams	Weight:	65%
Final mark for the Exams section: N_{Exam}, between 0 and 10. The final exam (ordinary or extraordinary) consists in the resolution of a number of practical problems that the student must solve using the knowledge learned throughout the course. In order to apply the marks obtained in other activities the mark N_{Exam} must be bigger than 4.		
Other Activities	Weight:	35%
The other assessment activities will consist of tests carried out in class during the term. The final mark for this section will be $N_{\text{OtherActiv}}$ and will range from 0 to 10.		
Final Mark		
Final mark: $C_{\text{Final}} = \max \{0.65 N_{\text{Exam}} + 0.35 N_{\text{OtherActiv}}, N_{\text{Exam}}\}$ Minimum mark on the final exam for weighting: $N_{\text{Exam}} \geq 4$. The final mark criterion, as well as the mark corresponding to other activities, will be maintained in the exam of the extraordinary call.		