NATIONAL UNIVERSITY OF SAN MARCOS

FACULTY OF MATHEMATICAL SCIENCES

SYLLABUS

1. GENERAL INFORMATION

1.1 Course name	:	Partial Differential Equations
1.2 Code	:	MA213
1.3 Academic Program	:	Scientific Computing
1.4 Credits	:	4
1.5 Prerrequisites	:	• MA212. Ordinary Differential Equations. (6^{th} Sem) • MA211. Calculus IV. (5^{th} Sem)
1.6 Type of Course	:	Mandatory
1.7 Area of Studies	:	Estudios Generales
1.8 Number of Weeks	:	16
1.9 Hours per week	:	2 HT; 4 HP;
1.10 Cycle	:	I
1.11 Learning modality	:	Face to face
1.12 Academic Period	:	2026-I
1.13 Semester Start Date	:	
1.14 Semester End Date	:	

2. PROFESSORS

Meetings after coordination with the professor

3. INTRODUCTION TO THE COURSE

The Partial Differential Equations course studies phenomena that depend on multiple variables, such as heat propagation, waves, and electrical potentials. The course introduces Fourier series and separation of variables methods to solve the classical equations of mathematical physics (Heat, Wave, and Laplace equations). It is a key component for advanced numerical simulation and continuum mechanics analysis.

4. GOALS

- Use Fourier series to represent periodic functions and solve boundary value problems.
- Solve linear partial differential equations using the separation of variables method.
- Classify second-order PDEs and understand their physical behavior.
- Apply finite difference numerical methods for solving PDEs.

5. COMPETENCES

No items for this table

6. TOPICS

Unit 1: Fourier Series and Sturm-Liouville Problems (24 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Orthogonal functions and sine and cosine Fourier series. • Complex Fourier series and Parseval's identity. • Eigenvalue problems and the Sturm-Liouville theorem. • Application of series to solving ODEs with boundary conditions.	• Implement basic ODE solvers (Euler, Runge-Kutta) [Usage] • Analyze the stability and convergence properties of ODE numerical methods [Assessment] • Select an appropriate numerical method for a given ODE based on stability and accuracy requirements [Assessment] • Solve systems of ODEs and convert higher-order ODEs to first-order systems [Usage]
Readings : [**Boyce2017**], [**Zill2018**]	

Unit 2: Diffusion Equations (Heat) (24 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Derivation of the heat equation in one dimension. • Separation of variables method for Dirichlet and Neumann conditions. • Heat problems in rods with insulated ends or radiation. • Heat equation in two and three dimensions (Cartesian coordinates).	• Implement root-finding algorithms (bisection, Newton, secant) and analyze their convergence [Usage] • Classify the order of convergence of iterative methods [Assessment] • Apply gradient descent to solve simple univariate optimization problems [Usage] • Design appropriate stopping criteria for iterative methods [Usage]
Readings : [**Boyce2017**], [**Zill2018**]	

Unit 3: Wave and Laplace Equations (24 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• The one-dimensional wave equation: Vibrating string. • D'Alembert's solution and traveling waves. • Laplace's equation in Cartesian and polar coordinates (Dirichlet Problem). • Steady-state applications and electrostatics.	• Construct interpolating polynomials using different methods [Usage] • Implement cubic spline interpolation [Usage] • Apply least squares method for data fitting [Usage] • Explain Runge's phenomenon and strategies to mitigate it [Familiarity] • Analyze the error of an interpolation scheme [Assessment]
Readings : [**Boyce2017**], [**Zill2018**]	

Unit 4: Numerical Methods for PDE and Transforms (24 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Introduction to the finite difference method for parabolic and elliptic PDEs. • Use of the Fourier Transform to solve PDEs in infinite domains. • Stability and convergence of basic numerical schemes. • Modeling of real-world problems using scientific computing software.	• Compute derivatives of functions using finite difference schemes [Usage] • Apply Richardson extrapolation to improve the accuracy of numerical approximations [Usage] • Implement numerical integration rules (Trapezoidal, Simpson, Gaussian) [Usage] • Compare the accuracy and efficiency of different numerical integration methods [Assessment] • Analyze the error for numerical differentiation and integration formulas [Assessment]
Readings : [**Boyce2017**], [**Zill2018**]	

7. WORKPLAN

7.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

7.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

7.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

8. EVALUATION SYSTEM

********* EVALUATION MISSING ********

9. BASIC BIBLIOGRAPHY