NATIONAL UNIVERSITY OF SAN MARCOS

FACULTY OF MATHEMATICAL SCIENCES

SYLLABUS

1. GENERAL INFORMATION

1.1 Course name	:	Ordinary Differential Equations
1.2 Code	:	MA212
1.3 Academic Program	:	Scientific Computing
1.4 Credits	:	6
1.5 Prerrequisites	:	• CS112. Objects-oriented programming I. (2^{nd} Sem) • MA121. Linear Algebra I. (3^{rd} Sem) • MA222. Real Analysis I. (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	:	4 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 Ordinary Differential Equations course provides the mathematical tools to analyze systems that evolve with respect to a single independent variable. It focuses on the modeling of dynamic systems through first-order equations, higher-order equations, and systems of equations, using both analytical and numerical methods. It is fundamental for the understanding of mechanics, electrical circuits, and population models.

4. GOALS

- Solve first-order and higher-order ordinary differential equations using analytical methods.
- Apply the Laplace transform to solve initial value problems involving discontinuous functions.
- Analyze the stability of linear and nonlinear systems of differential equations.
- Implement numerical methods for approximating solutions in complex models.

5. COMPETENCES

ABET-1) An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the discipline. (Usage)

6. TOPICS

Unit 1: First-Order Ordinary Differential Equations (20 hours)	
Competences Expected: ABET-1	
Topics	**Learning Outcomes**
• Modeling with first-order equations: growth, mixtures, and cooling	• Classify first-order ODEs and select an appropriate solution method (separation of variables, linear equation, exact equation, or integrating factor) [Familiarity] • Formulate and solve first-order models for growth and decay, mixing problems, Newton's law of cooling, and Torricelli's law [Usage] • Analyze autonomous first-order ODEs qualitatively using direction fields, and identify equilibrium points and their stability [Assessment]
Readings : [**Boyce2017**], [**Zill2018**]	

Unit 2: Higher-Order Differential Equations and Systems (40 hours)	
Competences Expected: ABET-1	
Topics	**Learning Outcomes**
• Definition and properties of the Laplace Transform; inverse transforms and translation theorems • Derivatives of a transform and convolution integrals	• State the Picard-Lindelöf existence and uniqueness theorem and interpret its implications for the continuation of solutions of a higher-order ODE [Familiarity] • Solve linear systems of ODEs using eigenvalue methods and sketch their phase portraits [Usage] • Apply the Laplace transform to solve ODEs with piecewise and impulsive forcing functions [Assessment]
Readings : [**Boyce2017**], [**Zill2018**]	

Unit 3: Numerical Methods for Differential Equations (36 hours)	
Competences Expected: ABET-1	
Topics	**Learning Outcomes**
• Phase portraits of 2D systems: equilibria, stability, and limit cycles • Stability of critical points and nonlinear systems	• Compare explicit and implicit ODE solvers and explain their relative stability for stiff problems [Familiarity] • Implement a Runge-Kutta method with adaptive step control and apply it to a system of ODEs [Usage] • Analyze the stability and convergence of a finite difference scheme for a parabolic PDE using the Lax equivalence theorem [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