# NATIONAL UNIVERSITY OF SAN MARCOS

FACULTY OF MATHEMATICAL SCIENCES

SYLLABUS

## 1. GENERAL INFORMATION

| | | |
|---|---|---|
| **1.1 Course name** | : | Capstone Project I |
| **1.2 Code** | : | MA401 |
| **1.3 Academic Program** | : | Scientific Computing |
| **1.4 Credits** | : | 3 |
| **1.5 Prerrequisites** | : | • MA361. Mathematical Modeling. ($7^{th}$ Sem)<br>• MA371. Functional analysis I. ($6^{th}$ Sem)<br>• 140cr |
| **1.6 Type of Course** | : | Mandatory |
| **1.7 Area of Studies** | : | Estudios Generales |
| **1.8 Number of Weeks** | : | 16 |
| **1.9 Hours per week** | : | 1 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

This course represents the first semester of the capstone project in computational mathematics. Students develop an applied research project or technological development that integrates and applies the knowledge acquired during the degree program. The course emphasizes problem formulation, literature review, methodological design, and initial development of computational solutions under the supervision of a faculty advisor. Projects must demonstrate research capability, innovation, and application of computational mathematics to real-world problems.

## 4. GOALS

- Formulate and delimit a research problem in computational mathematics with theoretical or applied relevance.
- Conduct a systematic literature review and state-of-the-art analysis related to the research problem.
- Design an appropriate methodology to address the problem, selecting suitable computational techniques and tools.
- Develop the initial phases of the project, including prototypes and preliminary analyses.
- Effectively communicate project progress through technical reports and oral presentations.
- Demonstrate autonomous work capability and project management under tutorial supervision.

## 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. (Assessment)

**ABET-2)** An ability to formulate or design a system, process, procedure, or program for the intended purpose. (Assessment)

**ABET-4)** An ability to communicate effectively with a range of audiences. (Assessment)

**ABET-5)** An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts. (Assessment)

**ABET-6)** An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty. (Assessment)

## 6. TOPICS

| **Unit 1: Project Formulation and Planning (12 hours)** | |
|---|---|
| **Competences Expected: ABET-1,ABET-2,ABET-4,ABET-5,ABET-6** | |
| **Topics** | **Learning Outcomes** |
| • Identification and delimitation of research problems<br>• Systematic literature review and state-of-the-art analysis<br>• Formulation of research objectives and hypotheses<br>• Methodological design and work plan<br>• Development of project proposal and schedule | • Formulate research problems with social impact [Evaluar]<br>• Design management plans for scientific projects [Usar]<br>• Conduct problem studies using research methods [Usar]<br>• Evaluate technical and scientific feasibility of projects [Evaluar] |
| **Readings :** [**Babbie2016**], [**Kothari2004**] | |

| **Unit 2: Methodological Development and Tools (12 hours)** | |
|---|---|
| **Competences Expected: ABET-1,ABET-2,ABET-4,ABET-5,ABET-6** | |
| **Topics** | **Learning Outcomes** |
| • Selection and justification of computational methods<br>• Design of experiments and validation protocols<br>• Computational tools for project development<br>• Version management and technical documentation<br>• Ethical considerations in computational research | • Apply ethical principles in professional research [Usar]<br>• Work effectively in multidisciplinary teams [Usar]<br>• Communicate technical progress effectively [Usar]<br>• Select appropriate tools for the project [Evaluar] |
| **Readings :** [**Oates2006**], [**Pressman2014**] | |

| **Unit 3: Implementation and Initial Development (12 hours)** | |
|---|---|
| **Competences Expected: ABET-1,ABET-2,ABET-4,ABET-5,ABET-6** | |
| **Topics** | **Learning Outcomes** |
| • Development of prototypes and proof of concepts<br>• Implementation of algorithms and computational methods<br>• Preliminary analysis of results and validation<br>• Iteration and refinement of solutions<br>• Technical documentation of development | • Learn independently and continuously [Usar]<br>• Conduct studies using research methods [Usar]<br>• Implement mathematical processes on computer [Usar]<br>• Adapt solutions based on preliminary results [Evaluar] |
| **Readings :** [**Sommerville2015**], [**McConnell2004**] | |

## 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