NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES

ENGINEERING PHYSICS PROGRAM

IF321 – NUMERIC CALCULUS I

I. GENERAL INFORMATION

CODE	**:**	IF321 Numeric Calculus I
SEMESTER	**:**	5
CREDITS	**:**	6
HOURS PER WEEK	**:**	8 (Theory – Practice)
PREREQUISITES	**:**	CC102 Programming Languages, CF251 Linear Algebra
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

This course prepares students in the application of numerical calculus methods for solving mathematical problems arising in engineering applications. Students analyze the concept of computing errors and discrete data, iterations processes and numeric stability and their application for solving linear and nonlinear equations, definite multiple integrals and ordinary differential equations. Students develop computer codes implementing the numerical methods and analyze obtained results.

III. COURSE COMPETENCIES

1. Have full consciousness of the presence of errors when taking measurements and making calculations. It classifies and interprets them.
2. Identify appropriate strategies for numerical solutions of problems related to engineering calculations solves them whit a computer.
3. Calculate numerical processes errors and give the appropriate interpretation of results.
4. Develop computer programs for implementing numeric algorithms.

IV. COURSE CONTENTS

1. BASIC KNOWLEDGE OF ERRORS

Error and its classification / Absolute and relative errors / Propagation of error / Stable and unstable processes / Calculation of a series, estimation of error / Criterion to finish an infinite process.

2. NON-LINEAR EQUATIONS

Models that drive us to solve a nonlinear equations / Closed methods (bisection) / Open methods (Secant, Newton) / Contracted functions / Consecutive approximation method / Computer codification.

3. LINEAR SYSTEMS OF EQUATIONS AND THE PROBLEM OF EIGENVALUES

Matrix norms and Conditioning / Eigenvalues and Eigenvectors / power iteration for the calculation of the largest eigenvalue in the module / Simple Gaussian elimination / Iterative methods: Jacobi, Gauss-Seidel / Computer codification.

4. FUNCTION APROXIMATION

Divided differences / Polynomial and trigonometric interpolation / Polynomial and trigonometric adjustment (discrete Fourier transform) / Non-linear adjustment / Computer codification.

5. **QUADRATURE**
Gauss quadrature / Trapeze method, open and closed cases / Romberg's method / Simpson's rule, open and closed cases / Computer codification.

6. **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS / 6 HOURS**
One-step methods: Euler, Runge-Kutta of order 4 / Finite difference and frontier differential equations / Computer codification.

V. LABORATORY AND PRACTICE

Laboratory 1: Errors, / Stable and unstable processes, series calculus
Laboratory 2: Non-linear equations
Laboratory 3: Linear systems and eigenvalues
Laboratory 4: Approximation
Laboratory 5: Approximation of a definite integral
Laboratory 6: Numerical solution of ordinary differential equations

VI. METHODOLOGY

The course takes place in sessions of theory and computer laboratory. In theory sessions, faculty presents the concepts, theorems, and applications. In laboratory sessions Mathcad software is used to implement numerical methods for solving problems and analyze their solutions. In every single session the active participation of the students is encouraged.

VII. GRADING SYSTEM

The Final Grade (PF) is calculated with the following formula:

PF = (EP + EF + PL) / 3

EP: Mid-term exam EF: Final Exam
PL: Average of computer laboratory experiences

VIII. BIBLIOGRAPHY

1. **Chapra S. & Canales R.**
Numerical Methods for Engineers
Edit. Mc Graw Hill . N.Y. 2010.

2. **Aljama C. Tomás , Cadena M. Miguel , Charleston V. , Miguel , Yañez S. Oscar**
Digital Signal Processing
Metropolitan Autonomous University, Mexico, 2008.