COLLEGE OF ENGINEERING
MECHANICAL AND ELECTRICAL ENGINEERING DEPARTMENT

Course name: NUMERICAL ANALYSIS
Course ID: 5709
Faculty Course ID:
University Course ID.: 01561 **CACEI ID:** CB
Study plan level: IMT:V, IEA:VII
Credits: 6
Normal hours per week: 3 **Total hours course:** 48
Lab hours per week: 0
Complementary practices:
Extra-class Work Hours / Week: 3
Course type: required
Approved credits needed:
Curricular last revision date: --/06/10

Prerequisite course: Algorithms and Data Structures

COURSE JUSTIFICATION

It is important for students to delve into issues related to tools for solving problems that arise in industry, private enterprises, service institutions, etc.., Moreover it provides great support to the development of programming skills and reinforces its inductive and deductive capabilities. The course is aimed at strengthening the programming skills to develop computer programs for mathematical procedures for solving problems arising in various disciplines.
It is desirable that the student has already completed the courses that give the basic knowledge such as differential and integral calculus, algebra, physics, and programming skills.

COURSE OBJECTIVE

The student will analyze and apply a range of basic tools for the approximate solution of various problems that arise in the different subjects, and the theory of these procedures will form their criteria for deciding whether a method is applicable, recommended, etc.
Added to this will solidify its programming skill to develop methods that are studied in the course.

COURSE TOPICS

UNIT 1
INTRODUCTION

OBJECTIVE: The student will understand the different types of errors, in order to identify if a method has approached to the correct solution.

TOPICS:

1.1 Round-off Errors
1.2 Chopping Errors
1.3 Absolute and Relative Errors

UNIT 2
SOLUTIONS OF EQUATIONS IN ONE VARIABLE

OBJECTIVE: The student will analyze and apply the most common methods for solving equations in one variable, which will provide basic training of numerical methods.

TOPICS:

2.1 The Bisection Method
2.2 The Secant Method
2.3 The Newton's Method
2.4 Extended Newton's Method

UNIT 3
SOLVING LINEAR SYSTEMS

OBJECTIVE: The student will deepen the knowledge of the methods for solving systems of linear equations, supporting significantly to the solution of engineering problems.

TOPICS:
3.1 Algebraic Methods (Gauss-Gauss Jordan)
3.2 Iterative Techniques (Jacobi and Gauss Seidel)
3.3 Special Types of Matrices

UNIT 4
CURVE FITTING

OBJECTIVE: The student will understand and apply the methods of least squares for curve fitting, which are used to represent the behavior of experimental processes.

TOPICS:
4.1 Least-Squares Regression
    4.1.1 Straight line
    4.1.2 Parabola or quadratic curve
4.2 Polynomial Regression

UNIT 5
INTERPOLATION AND POLYNOMIAL APPROXIMATION

OBJECTIVE: Students will strengthen their knowledge for adjustment data when these are few or incomplete.

TOPICS:
5.1 Lagrange Interpolating Polynomials
5.2 Newton's Divided-Difference
5.3 Cubic Spline Interpolation

UNIT 6
NUMERICAL DIFFERENTIATION AND INTEGRATION

OBJECTIVE: The student will study numerical methods for deriving and integrating equations and expand its criteria for making decisions regarding the application of analytical or numerical methods, taking advantage of numerical procedures for the traditional fast and easy programming.

TOPICS:
6.1 Numerical Differentiation
6.2 Numerical Integration

UNIT 7
SOLVING ORDINARY DIFFERENTIAL EQUATIONS

OBJECTIVE: The student will understand and apply the most common methods for the solution of ordinary differential equations (in addition to analytical methods) for quick and easy programming.

TOPICS:
7.1 Methods for Initial-Value Problems
    7.1.1 Euler Method
    7.1.2 Taylor Methods
    7.1.3 Runge-Kutta Methods (4^{th} and 5^{th} order)
7.2 Methods for Boundary-Value Problems
    7.2.1 Finite-Difference Methods

UNIT 8
NUMERICAL SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS

OBJECTIVE: The student will understand and apply the most common methods for solving partial differential equations (in addition to analytical methods) for quick and easy programming.

TOPICS:
8.1 Elliptic Equations
8.2 Parabolic Equations
8.3 Hyperbolic Equations

METHODOLOGY

The subject will be taught in the traditional manner, with the teacher's explanation. Coupled with homework, research and program development for the methods discussed. The Professor will indicate the methods that the student must submit as a requirement for consideration. When programming a numerical method is not required to submit examination will be considered as 20% of the evaluation.

EVALUATION CRITERIA

Evaluation according to the institutional rules must include four departmental exams, so the course evaluation will be as follows:

Exams	80%
Tasks or research	10%
Participation	10%

Note: In order for the course grade, the student must pass the theory course and must have accredited laboratory course (mandatory).

BIBLIOGRAPHY

TEXT BOOK:

Análisis Numérico
Richard L. Burden, Faires J. Douglas
Editorial Thomson Internacional
Séptima Edición, 2003.

Métodos Numéricos Para Ingenieros
Steven C. Chapra /Raymond P. Canale
Mc. Graw Hill Interamericana Editores S.A de C.V
Cuarta edición, 2003.

Applied Numerical Methods for Engineers and Scientists
Singiresu S. Rao
Prentice-Hall
Primera Edición, 2004

COMPLEMENTARY BIBLIOGRAPHY:

Numerical Methods For Engineers And Scientists
Joe D. Hoffman
Mcgraw Hill
México, D.F. 1992

Applied numerical methods for engineers using
MATLAB and C.
Robert J. Schilling, Sandra L. Harris
Pacific Grove, CA: Books/Cole, Ed.2000

Análisis Numérico con Aplicaciones
Gerald Curtis F.
Wheatley Patrick O.
Editorial Pearson Educación
Edición 2002.

SOFTWARE AND TICS

SOFTWARE TO USE:

INTERNET SITES:

MULTIMEDIA MATERIALS TO USE: