FACULTY OF **ENGINEERING**

DEGREE COURSE: **CIVIL AND ENVIRONMENTAL ENGINEERING BS**

SUBJECT: NUMERICAL ANALYSIS

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OBJECTIVES

This course is aimed at learning numerical algorithms for solving linear equation systems, nonlinear equations and ordinary differential equations.

CONTENTS

a. Introduction
    1. Presentation of course
    2. Introductory notions
    3. Numbering systems
    4. Errors and their sources
    5. Error propagation
b. Overview of matrices and vector spaces
    1. Matrices: Definitions and properties
    2. Determinant and inverse of a matrix
    3. Matrix operations
    4. Special matrices and vector spaces
c. Solution of linear equation systems
    1. Generalities on linear equation systems
    2. Definitions and fundamental theorems
    3. Direct methods: basic concepts
    4. Gauss elimination algorithm
    5. Pivoting strategy
    6. Solution of linear systems by matrix operation
    7. Gauss-Jordan algorithm
    8. LU factorization
    9. Cholesky algorithm
    10. Iterative methods : basic concepts
    11. Gauss-Seidel algorithm
    12. Jacobi algorithm
    13. Relaxation SOR and gradient algorithms
d. Solution of non-linear equations
    1. Generalities on non linear equations
    2. Bisection method
    3. False position method

4. Newton-Raphson method
5. Newton-Raphson method: weak points

LEARNING OUTCOMES:

Ability to deal, by means of numerical methods, with many problems of civil engineering, such as structural analysis and stress computation, analysis of hydraulic nets etc.

ASSESSMENT

Written exam: multiple choice and open questions

RECOMMENDED TEXTBOOKS

Lecture notes are sufficient to pass the examination with top grades.
Suggested further reading:

- K. J. Bathe and E. L. Wilson, Numerical Methods in Finite Element Analysis, Prentice-Hall, 1976
- Klaus-Jürgen Bathe. Finite Element Procedures in Engeneering Analysis. Prentice-Hall 1982
- Walter Gautschi. Numerical Analysis. Springer, 2012