University of Engineering and Technology
School of Computer Science
Syllabus of Course – Academic Period 2017-I

1. Code and Name: MA102. Math III
2. Credits: 4
3. Hours of theory and Lab: 4 HT;
4. Professor(s)
Meetings after coordination with the professor
5. Bibliography

[AR14] H. Anton and C. Rorres. *Elementary Linear Algebra, Applications Version.* 11th. Wiley, 2014.

[CC15] S.C. Chapra and R.P. Canale. *Numerical Methods for Engineers,* 7th. Vol. 1. McGraw-Hill, 12015.

6. Information about the course

(a) **Brief description about the course** This course introduces the first concepts of linear algebra as well as numerical methods with an emphasis on problem solving with the Scilab open source libe package. Mathematical theory is limited to fundamentals, while effective application for problem solving is privileged. In each subject, a few methods of relevance for engineering are taught. Knowledge of these methods prepares students for the search for more advanced alternatives, if required.

(b) **Prerrequisites:** MA101. Matemática II. (2^{do} Sem)

(c) **Type of Course:** Mandatory

7. Competences

- Ability to apply knowledge about Mathematics.
- Ability to apply engineering knowledge.
- Ability to apply the modern knowledge, techniques, skills and tools of modern engineering to the practice of engineering

8. Contribution to Outcomes

a) An ability to apply knowledge of mathematics, science. (**Assessment**)

j) Apply the mathematical basis, principles of algorithms and the theory of Computer Science in the modeling and design of computational systems in such a way as to demonstrate understanding of the equilibrium points involved in the chosen option. (**Assessment**)

9. Competences (IEEE)

C1. An intellectual understanding and the ability to apply mathematical foundations and computer science theory.⇒ **Outcome a**

C20. Ability to connect theory and skills learned in academia to real-world occurrences explaining their relevance and utility.⇒ **Outcome j**

C24. Understanding the need for lifelong learning and improving skills and abilities.⇒ **Outcome j**

10. List of topics

1. Introduction

2. Linear Algebra

3. Numerical methods

11. Methodology and Evaluation
Methodology:

Theory Sessions:
The development of the theoretical sessions is focused on the student, through his active participation, solving problems related to the course with the individual contributions and discussing real cases of the industry. The students will develop throughout the course a project of application of the tools received in a company.

Lab Sessions:
Practical sessions are held in the laboratory. Laboratory practices are performed in teams to strengthen their communication. At the beginning of each laboratory the development of the practice is explained and at the end the main conclusions of the activity in group form are highlighted.

Oral Presentations :
Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

Reading:
Throughout the course different readings are provided, which are evaluated. The average of the notes in the readings is considered as the mark of a qualified practice. The use of the UTEC Online virtual campus allows each student to access the course information, and interact outside the classroom with the teacher and with the other students.
Evaluation System:

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12. Content

Unit 1: Introduction (18)	
Competences Expected: C1	
Learning Outcomes	**Topics**
• Be able to understand the basic concepts and importance of Linear Algebra and Numerical Methods.	• Importance of linear algebra and numerical methods. Examples.
Readings : [AR14], [CC15]	

Unit 2: Linear Algebra (14)	
Competences Expected: C1	
Learning Outcomes	**Topics**
• Understanding the basics concepts of Linear Algebra. • Solve properly linear transformations problems.	• Elementary matrix algebra and determinants • Null space and exact solutions of systems of linear equations Ax=b: – Tridiagonal and triangular systems and Gaussian elimination with and without pivoting. – LU factorization and Crout algorithm. • Basics on eigenvalues and eigenvectors: – Characteristic polynomials. – Algebraic and geometric multiplicities. • Least squares estimation. • Linear transformations.
Readings : [AR14], [CC15]	

Unit 3: Numerical methods (22)

Competences Expected: C24

Learning Outcomes	**Topics**
• Understanding the basics concepts of Numerical Methods. • Applying the most frequent methods for the resolution of mathematical problems. • Implementing and applying numerical algorithms for the solution of mathematical problems using the Scilab open-source computational package. • Applying Scilab for the solution of mathematical problems and for plotting graphs.	• Basics on solutions of systems of linear equations Ax=b: Jacobi and Gauss Seidel methods. • Application of matrix factorizations to the solution of linear systems (singular value decomposition, QR, Cholesky) Numerical computation of null space, rank and condition number. • Root finding: – Bisection. – Fixed-point iteration. – Newton-Raphson methods. • Basics on interpolation: – Newton and Lagrange polynomial interpolations – Spline interpolation • Basics on numerical differentiation and Taylor approximation • Basics on numerical integration: – Trapezium, midpoint and Simpson rule – Gaussian quadrature • Basics on numerical solutions to ODEs: – Finite differences; Euler and Runge-Kutta methods – Converting higher order ODEs into a system of low order ODEs – Runge-Kutta methods for systems of equations – Single shooting method • Short introduction to optimization techniques: overview on linear programming, bounded linear systems, quadratic programming, gradient descent.

Readings : [AR14], [CC15]