San Pablo Catholic University (UCSP)
Undergraduate Program in
Computer Science
SILABO

Universidad Católica San Pablo
2020-I

MA102. Calculus I (Mandatory)

1. General information

1.1 School	:	Ciencia de la Computación
1.2 Course	:	MA102. Calculus I
1.3 Semester	:	3^{er} Semestre.
1.4 Prerrequisites	:	MA100. Mathematics I. (1^{st} Sem)
1.5 Type of course	:	Mandatory
1.6 Learning modality	:	Virtual
1.7 Horas	:	2 HT; 4 HP;
1.8 Credits	:	4

2. Professors

3. Course foundation

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.

4. Summary

1. Introduction 2. Linear Algebra 3. Numerical methods

5. Generales Goals

- 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

6. Contribution to Outcomes

This discipline contributes to the achievement of the following outcomes:

1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. (**Assessment**)

6) Apply computer science theory and software development fundamentals to produce computing-based solutions. (**Assessment**)

7. Content

UNIT 1: Introduction (18)	
Competences:	
Content	**Generales Goals**
• Importance of linear algebra and numerical methods. Examples.	• Be able to understand the basic concepts and importance of Linear Algebra and Numerical Methods.
Readings: Anton and Rorres (2014), Chapra and Canale (12015)	

UNIT 2: Linear Algebra (14)	
Competences:	
Content	**Generales Goals**
• 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.	• Understanding the basics concepts of Linear Algebra. • Solve properly linear transformations problems.
Readings: Anton and Rorres (2014), Chapra and Canale (12015)	

UNIT 3: Numerical methods (22)	
Competences:	
Content	**Generales Goals**
• 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.	• 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.
Readings: Anton and Rorres (2014), Chapra and Canale (12015)	

8. Methodology

El profesor del curso presentará clases teóricas de los temas señalados en el programa propiciando la intervención de los alumnos.

El profesor del curso presentará demostraciones para fundamentar clases teóricas.

El profesor y los alumnos realizarán prácticas

Los alumnos deberán asistir a clase habiendo leído lo que el profesor va a presentar. De esta manera se facilitará la comprensión y los estudiantes estarán en mejores condiciones de hacer consultas en clase.

9. Assessment
Continuous Assessment 1 : 20 % **Partial Exam** : 30 % **Continuous Assessment 2** : 20 % **Final exam** : 30 %

References

Anton, H. and C. Rorres (2014). *Elementary Linear Algebra, Applications Version.* 11th. Wiley.
Chapra, S.C. and R.P. Canale (12015). *Numerical Methods for Engineers,* 7th. Vol. 1. McGraw-Hill.