INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Calculus II			Field of study	Mathematical and Quantitative Methods		
Bachelor in	Informatics and Communications			School	School of Public Management, Communication and Tourism		
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9188-320-2102-00-22		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT 20	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Monica Penarroias Branco Carneiro

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Model and characterize situations involving infinite sequences of natural numbers.
2. Know the meaning of the integral function, the main techniques used for its achievement and its application to the calculation of areas of flat surfaces.
3. Build algorithms about numerical solution of nonlinear equations.
4. Build/develop models from experimental data.
5. Model and solve problems about approximation of functions due to difficulty or impossibility of analytical solving.
6. Interpret and control errors in approximations and iterative methods.
7. Analyse algorithms for approximated integral calculus.

Prerequisites

Before the course unit the learner is expected to be able to:
Apply the competences learnt in Calculus I and Linear Algebra courses.

Course contents

1) Introduction to Integral Calculus. 2) Sequences and real numeric series . 3) Errors. 4) Polinomial Approximation of Funtions. 5) Solutions of Nonlinear Equations. 6) Numerical Integration.

Course contents (extended version)

1. INTRODUCTION TO INTEGRAL CALCULUS
   - Primitive. Immediate primitives. Primitive tables.
   - Techniques of integration. Substitution and parcially.
   - Applications of integration in determination of plane surface areas.
2. SEQUENCES AND REAL NUMERIC SERIES
   - Sequences. Monotony, limitation and sequence convergence. Adition properties: revisions.
   - Series. Series of non-negative terms: the convergence criteria.
   - Alternating series of terms: absolute and conditional convergence.
   - Taylor Polynomials and McLaurin. Taylor and McLaurin series: properties and convergence.
   - Operations with power series.
3. THEORY OF ERRORS
   - Sources of errors. Truncation error and rounding error. Absolute error and relative error.
   - Upper limits of error. Fundamental formula of the theory of errors.
   - Truncation errors in calculating the sum of a convergent series.
4. SOLUTIONS OF NONLINEAR EQUATIONS
   - Introduction. Separation of roots. Finding number of roots using Rolle's Theorem or graphic method.
   - Direct methods, iterative methods and recursive methods. Bisection method.
   - False position method. Fixed point method (or simple iteration method).
   - Newton-Raphson method. Secant method.
5. POLINOMIAL APPROXIMATION OF FUNCTIONS
   - Interpolation. Lagrange interpolating polynomial. Divided differences.
   - Newton interpolating polynomial. Direct and inverse interpolation.
   - Approximation of functions by the method of least squares: introduction.
   - Principles of the method, the usual system of equations in matrix form.
6. NUMERICAL INTEGRATION
   - Introduction. Newton-Cotes formulas. Trapezoid rule. Simpson rule. Approach deferred.

Recommended reading

1. Cheney, W. and Kincaid, D. (2013). Numerical Mathematics and Computing. (7th Ed.) Brooks/Cole Cengage Learning [ISBN: 9781133491811]
2. Fernandes, E. (1988). Computação Numérica. Braga: Universidade do Minho [ISBN: 9729694419]
3. Stewart, J. (2008). Calculus: Early Transcendentals. (6th Ed.) USA: Thomson Brooks/Cole [ISBN: 9780495011668]
4. Swokowski, E. (1994). Cálculo com Geometria Analítica. Volume 1 (2ª Ed.) Makron Books [ISBN: 8534603081]
5. Valença, M. (1996). Análise Numérica. Lisboa: Universidade Aberta [ISBN: 9726741955]

Teaching and learning methods

TEACHING AND LEARNING METHODS Classes will be fit-oriented to: overpass difficulties; show examples using audio means; exploit examples related with case studies; simulate examples using computer; discuss working proposals; share successes and difficulties.

Assessment methods

1. Continuous Evaluation (incoming students) - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 20% (Integral Calculus (min 7.0 in 20))
   - Intermediate Written Test - 20% (Sequential and Numerical Series (min 7.0 in 20))
   - Intermediate Written Test - 10% (Theory of errors (min 7.0 in 20))
   - Practical Work - 20% (Implementation of methods: Nonlinear equations. (min 7.0 in 20))
   - Practical Work - 20% (Implementation of methods: Polynomial interpolation. (min 7.0 in 20))
   - Case Studies - 10% (Choose an exercise for Numerical Integration and analyze the method used. (min 7.0 in 20))
2. Distributed Evaluation (incoming students) - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 60% (Integral Calculus and numerical integration; sequences and real numerical series. (min 7.0 in 20))

Assessment methods

- Practical Work - 40% (Implementation of methods:Nonlinear equations; Polynomial interpolation. (min 7. 0 in 20))

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Monica Penarroias Branco Carneiro	Vítor José Domingues Mendonça	Elisabete da Anunciacao Paulo Morais	Luisa Margarida Barata Lopes
03-10-2022	09-10-2022	10-10-2022	14-10-2022