![ipb INSTITUTO POLITÉCNICO DE BRAGANÇA]

Course Unit	Mathematics II	Field of study	Mathematics	
Bachelor in	Renewable Energy Engineering	School	School of Technology and Management	
Academic Year	2021/2022	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9910-743-1204-00-21	

| Workload (hours) | 162 | Contact hours | T | - | TP | 60 | PL | - | TC | - | S | - | E | - | OT | - | 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)	Paula Maria Pereira de Barros

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Determining partial derivatives. Determining the tangent plane to a surface.
2. Determining and classifying the extrema of a real-valued function. Applying the method of Lagrange multipliers.
3. Applying the Laplace Transform to solve initial value problems.
4. Solving first order ordinary differential equations and initial value problems.
5. Applying integrals to evaluate areas, volumes and centers of mass. Parametrizing surfaces.
6. Evaluating the gradient, divergence and curl of a vector field. Applying the theorems of vector calculus.

Prerequisites

Before the course unit the learner is expected to be able to:
To solve problems and applying the skills/knowledge acquired in Mathematics I.

Course contents

Real-valued functions of several variables. Ordinary differential equations. Laplace Transform. Double and triple Integrals. Vector calculus.

Course contents (extended version)

1. Real-valued functions of several variables:
    - The geometry of real-valued functions of several variables.
    - Limits and continuity.
    - Partial derivatives.
    - Chain rule and implicit function theorem.
    - Gradients and directional derivatives. Tangent plane.
    - Extrema of real-valued functions. Constrained extrema and Lagrange multipliers.
2. Ordinary Differential Equations (ODEs):
    - Ordinary differential equations of the first order.
    - Ordinary differential equations of order greater than one.
    - Initial value problems.
3. Laplace transform:
    - Definition and basic properties of the Laplace Transform.
    - Inverse Laplace transform.
    - Application to initial value problems.
4. Double and Triple Integrals:
    - Double and triple integrals over elementary regions.
    - Fubini's theorem.
    - Change of variables in double and triple integrals.
    - The change of variables theorem.
    - Applications of double and triple integrals.
5. Vector Calculus:
    - Line integral and path integral.
    - Length of a parametrized curve.
    - Work done by a force field over a path.
    - Parametrized surfaces.
    - Integrals of scalar functions and vector fields over surfaces.
    - Area of a surface.
    - Curl and divergence of a vector field.
    - The integral theorems of vector analysis: Green, Stokes and Gauss' theorems.

Recommended reading

1. Anton, H. , Bivens, I. & Davis, S. (2007). Cálculo (vol. II). Porto Alegre: Bookman.
2. Borrelli, R. & Coleman, C. (2004). Differential Equations: A Modeling Perspective. Wiley.
3. Marsden, J. & Tromba, A. (2003). Vector Calculus. Freeman.
4. Stewart, J. (2005). Cálculo (Vol. I e II). São Paulo: Thomson.

Teaching and learning methods

Topics will be presented and explored in class. There will be individual and group sessions outside class to accompany the student's work.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
    - Practical Work - 20%
    - Intermediate Written Test - 40%
    - Intermediate Written Test - 40%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary)
    - Intermediate Written Test - 50%
    - Intermediate Written Test - 50%
3. Alternative 3 - (Regular, Student Worker) (Supplementary, Special)
    - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Paula Maria Pereira de Barros	Florbela Alexandra Pires Fernandes	Ana Maria Alves Queiroz da Silva	Paulo Alexandre Vara Alves
06-03-2022	08-03-2022	09-03-2022	18-03-2022