INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Applied Mathematics II			Field of study	Mathematics		
Bachelor in	Biomedical Technology			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9600-752-1204-00-23		

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): Mário António Rodrigues Grande Abrantes

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Solve problems using: (i) the differential of a function f(x); (ii) Euler's Formula; (iii) the decomposition into partial fractions; (iv) the chain rule with multiple variables.
2. Solve some types of 1st order ordinary differential equations (DEs), and 2nd order linear DEs; solve simple pratical problems involving these types of DEs.
3. Solve differential equations using Laplace transforms, whose second member involves distributions such as the Heaviside step function and the Dirac's Delta.
4. Calculate double and triple integrals directly or by changing the order of integration and use of appropriate coordinates.
5. Apply double and triple integrals when calculating areas and volumes.
6. Parameterize curves and surfaces and calculate the length of a curve and the area of a surface.
7. Calculate the gradient of a function and the curl and divergence of a vector field.
8. Apply the integral theorems of vector analysis: Green, Stokes and Gauss.

Prerequisites

Before the course unit the learner is expected to be able to:
Solve problems and apply the skill/knowledge acquired in Cálculo I and ALGA.

Course contents

Complements of derivatives and integrals. Ordinary differential equations. Laplace transform. Double and triple integration. Vector calculus.

Course contents (extended version)

1. Ordinary Differential Equations (ODEs):
   - First order ODEs: singular, particular and general solution.
   - Cauchy's problem. Separable, exact, and linear differential equations. Bernoulli equation.
   - The theorem of existence of solution for Cauchy's problem.
   - Problems leading to first order ODEs.
   - ODEs of order n: constant coefficients homogeneous equation. Cauchy's problem.
   - Linear differential equations of order greater than one: General solution and particular solution.
   - Homogeneous and non-homogeneous equations, constant coefficients and Euler-Cauchy's equation.
   - Method of undetermined coefficients, method of variation of parameters.
   - Problems leading to ODEs with order greater than one.
2. The Laplace Transform:
   - Definition and basic properties.
   - Existence of the Laplace transform.
   - The inverse transform.
   - Properties of Laplace transform.
   - Solution of differential equations by means of Laplace transforms.
   - The shift theorems.
3. Double and Triple Integrals:
   - Double and triple integrals over elementary regions.
   - Fubini's theorem.
   - Change of variables in double and triple integrals: polar and cylindrical coordinates.
   - The change of variables theorem.
   - Applications of double and triple integrals.
4. Vector Calculus:
   - Paths in the plane and in the space.
   - Line integral and path integral.
   - Length of a parameterized curve.
   - Work done by a force field over a path.
   - Parameterized surfaces.
   - Integrals of scalar functions and vector fields over surfaces.
   - Area of a surface.
   - Gradient, curl and divergence.
   - The integral theorems of vector analysis: theorems of Green, Stokes and Gauss.

Recommended reading

1. Stewart, J. (2005). Cálculo Volume I e II, 5ª edição, Cengage Learning.
2. Marsden, J. M. , & Tromba, A. J. (2003). Vector Calculus, 5ª ed. , Freeman.
3. Fernandes, F. P. (2024). Theory, Problems and Exercises for Calculus II, DMat -- ESTiG
4. Anton, H. , Bivens, I. , Davis, S. (2007). Cálculo Volume II, 8ªed. , Bookman.
5. Abrantes, Mário (2022), Sebentas de CálculoI/Cálculo II (www. ipb. pt/~mar)

Teaching and learning methods

Course contents will be introduced in lectures. Complementary, there will be tutorial and practical classes where the students are guided in the accomplishment of practical exercises focusing on applications of theoretical concepts.

Assessment methods

1. Continuous assessment (portuguese classes) - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 65% (Evaluation work carried out during the semester.)

Assessment methods

- Final Written Exam - 35% (Written test on all subjects taught during the semester, held at the end of the semester.)

2. Partial Exams for students with english classes - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 50% (Partial Exam 1: At the end of ODE's and Laplace transform chapter.)
   - Intermediate Written Test - 50% (Partial Exam 2: At the end of double and triple integration and vectorial calculus.)
3. Final Exam - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Final exam)

Language of instruction

1. Portuguese
2. English

Electronic validation

Mário António Rodrigues Grande Abrantes	Florbela Alexandra Pires Fernandes	Joana Andrea Soares Amaral	José Carlos Rufino Amaro
11-03-2024	12-03-2024	15-03-2024	24-03-2024