Course guide
240131 - 240131 - Differential Equations

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: PERE GUTIERREZ SERRES

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

TEACHING METHODOLOGY

There are 2 hours per week of "magistral lectures" (exposition of theoretical aspects), and 2 hours per week of "problem solving".

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, students should be able:
* to apply the fundamental theorems of Vector Calculus
* to solve, classify and draw the phase portrait of 2D and 3D systems of linear ODEs with constant coefficients
* to use the tools to determine the stability in some systems of nonlinear ODEs
* to solve some basic PDEs (wave, heat, Laplace/Poisson, etc)
* to use sofware in order to obtain numerical approximations in problems from the previous items

STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	40.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Vector Calculus

Description:
Line and surface integration of functions and vector fields. Integral theorems: Newton_Leibniz, Green, Gauss and Stokes.

Related competencies :
CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 65h
Theory classes: 13h
Practical classes: 13h
Self study : 39h

Ordinary Differential Equations (ODEs)

Description:
Initial and boundary value problems. Stability and classification of linear systems with constant coefficients. Stability of nonlinear systems. Modeling.

Related competencies :
CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 60h
Theory classes: 12h
Practical classes: 12h
Self study : 36h

Partial Differential Equations (PDEs)

Description:
Wave, heat and Laplace/Poisson equations. Conservation laws. D'Alembert formula. Separation of variables.

Related competencies :
CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 25h
Theory classes: 5h
Practical classes: 5h
Self study : 15h

GRADING SYSTEM

A partial exam (EP), a final exam (EF) and a practice exam (M). The final score is 0.35*EP+0.55*EF+0.1*M. The reevaluation exam (R) is a single test and its score replaces the previous EP and EF scores, and hence the final score, in this case, becomes 0.9*R+0.1*M (to be maximized with the final score previously obtained).

EXAMINATION RULES.

In the partial and final exams, only a sheet made by oneself can be used. For the practice exam, the allowed material will previously be announced. The use of a calculator, a primitive table or other tables, and (of course) mobile phones or similar devices is not allowed. Changes of group are not allowed.

BIBLIOGRAPHY

Basic:
- P. Pascual (ed.) et al. Càlcul integral per a enginyers [on line]. Barcelona: UPC, 2002 [Consultation: 07/04/2017]. Available on: http://hdl.handle.net/2099.3/36742. ISBN 8483016273.
- Zill, Dennis G.. Ecuaciones diferenciales con aplicaciones de modelado. 11ª ed.. México DF: Cengage Learning Editores, 2018. ISBN 9786075266312.

Complementary:
- Quarteroni, Alfio, F. Saleri. Cálculo científico con MATLAB y Octave [on line]. Milano: Springer, 2006 [Consultation: 15/06/2018]. Available on: http://dx.doi.org/10.1007/978-88-470-0504-4. ISBN 9788847005037.
- Marsden, Jerrold E. ; A.J. Tromba. Cálculo vectorial. 6ª ed.. Madrid: Pearson, 2018. ISBN 9788490355787.
- R. Larson i B.H. Edwards. Cálculo 2 de varias variables [on line]. 9ª ed.. México DF: McGraw-Hill, 2010 [Consultation: 19/10/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686. ISBN 9789701071342.
- R.L. Borrelli i C.S. Coleman. Ecuaciones diferenciales : una perspectiva de modelación. México: Oxford Univ. Press, 2002. ISBN 9706136118.
- M. Tenenbaum i H. Pollard. Ordinary differential equations. New York: Dover, 1985. ISBN 0486649407.

RESOURCES

Other resources:
https://mat-web.upc.edu/etseib/ed/