Course guide
280639 - 280639 - Mathematical Methods for Engineering

Last modified: 27/05/2024

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 9.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: MARIA MONTSERRAT VELA DEL OLMO

Others: Primer quadrimestre:
JOAN CARLES LARIO LOYO - GTM
MARIA MONTSERRAT VELA DEL OLMO - DT, GESTN, GTM

PRIOR SKILLS

Know the topics of Fonaments de Matemàtiques I i II.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE0. Ability to solve math problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry to, differential and integral calculus, differential equations and partial differential, numerical methods, algorithmic numerical and statistical optimization.
GESTN.CE1. Ability to solve math problems that may arise in the field of naval engineering technology. Ability to apply knowledge of: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial, numerical methods, numerical algorithms, statistical and optimization.

TEACHING METHODOLOGY

- Receive, understand and summarize knowledge.
- Posing and solving problems.
- Developing arguments from a critical point of view and defending them.
- Doing work in group and individually.

LEARNING OBJECTIVES OF THE SUBJECT

- To solve the mathematical problems that arise in engineering.
- To be able to apply the knowledge on differential geometry and vectorial calculus, differential equations, integral transforms and optimization.
- To develop the cpacity of abstraction while solving problems.
- To recognize the aims of the group and to plan for being able to reach them.
- To identify the responsabilities of each member and assume the corresponding commitments.

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,0	17.78
Self study	126,0	56.00
Hours medium group	50,0	22.22
Guided activities	9,0	4.00

Total learning time: 225 h

CONTENTS

1. Vector functions

Description:
Vectors and vector functions. Derivation and integration of vectors. Analytic description of the space: coordinates. Vector description of the space.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

2. Curves, surfaces and solids

Description:
Parametritzation. Tangent and nomal vectors. Computation of lenghts, areas and volumes.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

3. Scalar and vector fields

Description:
Scalar fields: description, gradient. Integration of scalar fields. Vector fields: description, divergence and curl. Integration of vector fields. Laplacian and second derivatives of the fields.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

4. Flux and circulation of vector fields

Description:
Flow of a vector field through a surface. Density of flow: divergence. Divergence theorem. Solenoidal fields.
Circulation of a vector field along a line. Density of circulation: curl. Stokes theorem. Conservative fields and potential function.

Full-or-part-time: 31h
Theory classes: 12h
Guided activities: 4h
Self study : 15h

5. Ordinary differential equations.

Description:
Linear ordinary differential equations. Solutions as power series. Boundary value problem, eigenvalues and eigenfunctions. Numerical resolution: methods of Euler and Runge-Kutta.

Full-or-part-time: 28h 30m
Theory classes: 12h
Self study : 16h 30m

6. Integral transforms

Description:
Laplace transform: definition and properties. Application to solve linear ordinary differential equations (ODE's).
Fourier transform: definition, properties, inverse transform. Convolution.
Step and impulse ('delta'-Dirac) functions. Transfer function of a system.

Full-or-part-time: 30h
Theory classes: 12h
Self study : 18h

7. Partial differential equations

Description:
Difinition and basic concepts. Method of separation of variables. Wave equation: vibrating string. Fourier equation: heat propagation in a rod. Laplace equation. Numerical methods to solve partial differential equations.

Full-or-part-time: 44h 30m
Theory classes: 18h
Guided activities: 4h
Self study : 22h 30m

8. Optimization.

Description:
Definition and basics concepts. Linear programming. Simplex method.

Full-or-part-time: 16h
Theory classes: 6h
Guided activities: 1h
Self study : 9h

GRADING SYSTEM

The final grade, Nfinal, is obtained from the results of partial exercices (exams, tests,...) and the rating of activities (exercises, assignments, ...) that will take place throughout the semester, according to the expression:
Nfinal = 0,90 * Nex + 0,10 * Nc
where: Nex = average of the ratings of the partial exercices
Nc = rating of the course activities.

Any activity or exercise not presented have a score of 0 points.
Reevaluation: If you have obtained a grade between 3 and 4.9, you can choose to reassessment will consist of a final test.

EXAMINATION RULES.

- The exams are required.
- Not passed the exams will be recovered at the end of course exam.
- The final exam will also be presented students who, having completed a partial wish to improve their grade.

BIBLIOGRAPHY

Basic:

- Kreyszig, E. Matemáticas avanzadas para ingeniería. 3a ed. Madrid: Limusa Willey, 2000. ISBN 9789681853105 (V.1) 9789681853113 (V.2).
- Salas, S.L.; Hille, E. Calculus, vol. 2. 4a ed. Barcelona: Reverté, 2002. ISBN 9788429151589 (V.2).
- Braun, M. Ecuaciones diferenciales y sus aplicaciones. Mexico: Fondo educativo interamericano, 1990. ISBN 9687270586.

Complementary:

- Marsden, J.E; Tromba, A.J. Cálculo vectorial [on line]. 6a ed. Madrid: Pearson, [2018] [Consultation: 30/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7634. ISBN 9788490355787.
- Simmons, G.F. Ecuaciones diferenciales con aplicaciones y notas históricas. Madrid: McGraw-Hill Interamericana, 1993. ISBN 844810045X.
- Riley, K.F.; Hobson, M.P.; Bence, S.J. Mathematical methods for physics and engineering. 3rd ed. Cambridge: Cambridge University Press, 2006. ISBN 0521679710.