



Course guide

330519 - EFVFE - Finite Elements and Finite Volumes for Engineering

Last modified: 04/05/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.
Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).
Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: Cors Iglesias, Josep M.

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE1. Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimization.

General:

CG3. Knowledge of basic and technological subjects that will enable students to learn new methods and theories and that will endow them with the versatility needed to adapt to new situations.

Transversal:

2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
3. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:

CB1. Students will be able to demonstrate their knowledge of a field of study that builds on secondary education and is usually found at a level that, while supported by advanced textbooks, also includes aspects that involve knowledge of the latest developments in the field of study.

CB2. Students will be able to apply their knowledge to their work or vocation in a professional manner and demonstrate that they possess the competencies that are typically demonstrated by elaborating and defending arguments and solving problems in the field of study.

TEACHING METHODOLOGY

MD1 Master class or conference (EXP)

MD2 Troubleshooting (PR)

MD5 Project or activity (PR)

MD7 Assessment activities (EV)

LEARNING OBJECTIVES OF THE SUBJECT

Learning the basic concepts of the finite element method, in order to develop analytical skills and logical thinking, increasing the ability to abstract and generalize. Apply knowledge to solve problems, establishing methods and algorithms for solving them. Obtain and interpret results with computer tools.



STUDY LOAD

Type	Hours	Percentage
Hours large group	22,5	20.00
Hours small group	22,5	20.00
Self study	67,5	60.00

Total learning time: 112.5 h

CONTENTS

Content title 1: Introduction to finite elements method

Description:

Calculus of variations. Interpolation and functions approximation. Quadrature.

Specific objectives:

Ability to understand the finite element method as an adaptation of variational methods.

Related activities:

1,2,3,4,5

Full-or-part-time: 37h 30m

Theory classes: 7h 30m

Laboratory classes: 7h 30m

Self study : 22h 30m

Content title 2: One-dimensional stationary problems

Description:

Discretization. Element equations.. Assembling the elements. Applying the boundary conditions. Solving the system. Examples.

Specific objectives:

Ability to apply the finite element method to stationary one-dimensional problems.

Related activities:

1,2,3,4,5

Full-or-part-time: 37h 30m

Theory classes: 7h 30m

Laboratory classes: 7h 30m

Self study : 22h 30m



Content title 3: Two-dimensional stationary problems

Description:

Discretization. Weak formulation. Element equations.. Assembling the elements. Applying the boundary conditions. Solving the system. Examples.

Specific objectives:

Ability to apply the finite element method to stationary two-dimensional problems.

Related activities:

1,2,3,4,5

Full-or-part-time: 37h 30m

Theory classes: 7h 30m

Laboratory classes: 7h 30m

Self study : 22h 30m

ACTIVITIES

Title of activity 1: Theoretical classes

Description:

Presentation of the theoretical part and its applications.

Specific objectives:

Those corresponding to the contents 1,2,3.

Material:

Digital campus documents and basic bibliography.

Full-or-part-time: 39h

Theory classes: 19h 30m

Self study: 19h 30m

Title of activity 2: Classes of problems

Description:

Approach and problem solving.

Specific objectives:

Those corresponding to the contents 1,2,3.

Material:

Exercise statements on the digital campus and basic bibliography.

Full-or-part-time: 35h 30m

Laboratory classes: 13h 30m

Self study: 22h



Title of activity 3: Laboratory classes

Description:

Implementation of the theoretical part with Matlab.

Specific objectives:

Those corresponding to the contents 1,2,3.

Material:

Scripts on the digital campus.

Full-or-part-time: 20h

Laboratory classes: 7h 30m

Self study: 12h 30m

Title of activity 4: Written partial tests

Description:

Two tests learning control.

Specific objectives:

Those corresponding to the contents 1,2,3.

Material:

Test statements.

Delivery:

Individual answers.

Full-or-part-time: 12h

Theory classes: 3h

Self study: 9h

Title of activity 5: Laboratory tests

Description:

Practical test at the computer room.

Specific objectives:

Those corresponding to the contents 1,2,3.

Material:

Test statement.

Delivery:

Individual answers.

Full-or-part-time: 6h

Laboratory classes: 1h 30m

Self study: 4h 30m

GRADING SYSTEM

Grade will be calculated from the following expression:

$$NFC = 0.20 * MA + 0.35 * EP1 + 0.45 * EP2$$

where MA is the result of tests with Matlab. EP1 and EP2 the grades of the first and second partial examination, respectively.

The final grade of the course will be calculated from the following expression

$$NF = \max \{NEF, NFC\}$$

where $NEF = \max\{0.20*MA+0.80*EF, 0.10*MA+0.90*EF\}$ and EF the final exam grade.

EXAMINATION RULES.

An unperformed activity carries a grade of zero in that activity.

BIBLIOGRAPHY

Basic:

- Masdemont Soler, Josep. Curs d'elements finits amb aplicacions [on line]. Barcelona: Edicions UPC, 2002 [Consultation: 19/11/2020]. Available on: <http://hdl.handle.net/2099.3/36166>. ISBN 8483015951.

Complementary:

- Bonet, Carles, i altres. Càlcul numèric [on line]. Barcelona: Edicions UPC, 1994 [Consultation: 19/11/2020]. Available on: <http://hdl.handle.net/2099.3/36356>. ISBN 8476533764.

RESOURCES

Other resources:

Notes and / or slides related to the theoretical and practical classes.

List of problems.