UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Course guide
330528 - CEV - Structural Calculations of the Vehicle

Last modified: 04/05/2023

Unit in charge:	Manresa School of Engineering
Teaching unit:	750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

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

LECTURER

Coordinating lecturer:	Ordóñez Espinoza, Jorge Andrés
	Felipe Blanch, Jose Juan De
Others:	Ordóñez Espinoza, Jorge Andrés

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE26. Basic knowledge and application of environmental technologies and sustainability (Specific competence of the mention of Industrial Technologies).

Generical:
CG1. Ability to write and develop projects in the field of automotive engineering for the construction, renovation, repair, maintenance, recycling, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, plants and industrial plants and manufacturing and automation processes.
CG2. Capacity for management of the activities that are the subject of the engineering projects described in the previous section.
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.
CG4. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and skills in the field of automotive engineering.
CG7. A capacity for analysing and assessing the social and environmental impact of technical solutions.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
3. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

Basic:
CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
CB4. Students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience.

TEACHING METHODOLOGY

MD1 Master class or conference (EXP)
MD2 Problem solving and case study (RP)
MD3 Practical lab work or workshop (TP)
MD5 Project, activity or reduced work (PR)
MD7 Project or broad work (PA)

LEARNING OBJECTIVES OF THE SUBJECT

The subject intends to provide basic knowledge about the construction of vehicles.

Among the different learning objectives are:
- Know the characteristics of the different types of constructive vehicles (racks / chassis / bodywork).
- Know and apply the techniques of calculation of construction of vehicles (virtual work, flexibility and rigidity method).
- Know and apply the structural modeling techniques of the vehicle.
- Know the different types of union used: threaded, welded, riveted, patches, etc.

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	20.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

1. Vehicle structure: racks, chassis and bodywork

Description:
Definition, function, typology, nomenclature and history of racks, chassis and bodywork.

Specific objectives:
Understanding and analysis of the different structural components of a vehicle and when and why they are used according to the type of the vehicle.

Related activities:
Specific work on content (Activity 1)

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

2. Introduction to structural analysis

Description:
Structures, efforts, supports, knots, reactions and actions, linear theory, degree of hyperestaticity, degree of freedom

Specific objectives:
Comprehension, analysis, simple structures, determination of efforts and reactions and application of the linearity theory of the relationship between tensions and deformations. Understanding and analysis of isostatic, hyperestatic and hypostatic structures.

Related activities:
Specific work on content (Activity 2 & 6)

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

3. Deformation energy and Navier-Bresse equations

Description:
Energy equations and Navier-Bresse equations. Application to structural calculation to solve hyperstatic and isostatic structures.
Linking your results (eg turns and displacements) with the flexibility and stiffness methods.

Specific objectives:
Understand the theoretical bases of the calculation of structures through the energetic theorems i of them eq. Navier-Bresse,
apply them to the calculation of structures and verify their link with matrix analysis

Related activities:
Specific work on content (Activity 3 & 6)

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

4. Principle of Virtual Work. Special cas of the energetic methods

Description:
Application of the principle of virtual works to structural calculation. Application of the unit load method to hyperstatic and
isostatic structures. Linking your results with the flexibility and rigidity methods.

Specific objectives:
Understanding, analysis and application of the principles of virtual work in isostatic and hyperstatic structures

Related activities:
Specific work on content (Activity 4 & 6)

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

5. Introduction to matrix analysis. Methods of flexibility and rigidity

Description:
Application of the method of flexibility (hyperstatic) and rigidity for the calculation analysis of hyperstatic and isostatic structures

Specific objectives:
Understanding, analysis and application of the methods of flexibility and rigidity for the analysis and calculation of hyperstatic and
isostatic structures

Related activities:
Specific work on content (Activity 5 & 6)

Full-or-part-time: 40h
Theory classes: 8h
Laboratory classes: 8h
Self study : 24h

6. Unions

Description:
Mechanical behavior and type of: Welding, rivets, threaded joints, glued joints, etc.

Specific objectives:
Understanding, analysis of the mechanical behavior of welding, rivets, threaded joints, glued joints.

Related activities:
Specific work on content (Activity 6)

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

ACTIVITIES

1. Typologies of racks, chassis and bodywork

Description:
Carry out a work on the automotive sector of those proposed by the teacher. Your public exposure must be made. (Evaluation of the transversal competence "Teamwork level 3")

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "ATENEA"

Delivery:
5 % of the evaluation

Full-or-part-time: 6h
Theory classes: 1h
Self study: 5h

2. Tensions and efforts in a structure

Description:
Carry out a series of problems on the subject: to determine the different tensions and efforts in a structure. Determine the degree of hyperestatism of a structure proposed by the teacher. Your written delivery must be made.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "ATENEA"

Delivery:
10 % of the evaluation

Full-or-part-time: 9h 36m
Laboratory classes: 4h
Self study: 5h 36m

3. Equactions of Navier Bresse

Description:
Make a model and find and turns and displacements analytically / numerically using the eq. Navier-Bresse. Your written delivery must be made. The activity can be completed with the performance of laboratory practices with the corresponding reports and / or control questions either by means of specific examinations or questionnaires.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "ATENEA"

Delivery:
10 % of the evaluation

Full-or-part-time: 7h 36m
Laboratory classes: 2h
Self study: 5h 36m

3. Principle of virtual work

Description:
Make a model of a car and found a piece of stress and strain for analytical / numerical fen used PVT. Your public exposure must be made.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "ATENEA"

Delivery:
20 % of the evaluation

Full-or-part-time: 7h 36m
Laboratory classes: 2h
Self study: 5h 36m

4. Flexibility method

Description:
Make a model of a car and found a piece of stress and strain for analytical / numerical fen used MF. Your public exposure must be made.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "Atenea"

Delivery:
25 % of the evaluation

Full-or-part-time: 11h 24m
Laboratory classes: 3h
Self study: 8h 24m

6. Test

Description:
Write a written test on the whole subject.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Third language
Tradueix de: castellà
43/5000
Solvent use of information resources

Material:
In the digital campus "ATENEA"

Delivery:
30 % of the evaluation

Full-or-part-time: 16h
Theory classes: 1h
Self study: 15h

GRADING SYSTEM

Activity 1: 5% grade
Activity 2: 10% grade
Activity 3: 10% grade
Activity 4: 20% grade
Activity 5: 25 % grade
Activity 6: 30 % grade

BIBLIOGRAPHY

Basic:
- Rivera Amores, Juanjo. Mecànica de materials i càlcul d'estructures [on line]. Barcelona: Universitat Politècnica de Catalunya. Iniciativa Digital Politècnica, 2014 [Consultation: 27/05/2020]. Available on: http://hdl.handle.net/2099.3/36628. ISBN 9788498804539.
- Ortiz Berrocal, Luis. Resistencia de materiales [on line]. 3a ed. Madrid [etc.]: McGraw-Hill, 2007 [Consultation: 02/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3962. ISBN 9788448156336.
- Beer, Ferdinand Pierre; Johnston, E. Russell; DeWolf, John T; Mazurek, David F; Dorador, Jesús Manuel. Mecánica de materiales [on line]. Séptima edición. México: McGraw-Hill Education, 2017 [Consultation: 08/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8071. ISBN 9781456260866.
- Martín Navarro, José. Elementos fijos: carrocería. 5ª ed. Madrid: Paraninfo, 2010. ISBN 9788497327688.
- Cervera Ruiz, Miguel; Blanco Díaz, Elena. Mecánica de estructuras [on line]. Barcelona: Edicions UPC, 2001-2002 [Consultation: 06/11/2020]. Available on: http://hdl.handle.net/2099.3/36196. ISBN 848301517X.
- Hibbeler, R. C; Murrieta Murrieta, Jesús Elmer; Juárez Luna, Gelacio; Sepúlveda García, David. Análisis estructural [on line]. 8a ed. Naucalpán de Juárez, México: Pearson, cop. 2012 [Consultation: 10/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1517. ISBN 9786073210621.
- Leet, Kenneth M; Uang, Chia-Ming; Sordo Zabay, Emilio; Arrioja Juárez, Raúl. Fundamentos de análisis estructural. 2ª ed. Madrid: McGraw-Hill, cop. 2006. ISBN 9789701056271.
- Ros Felip, Antonio; Casteleiro Villalba, José Manuel. Plasticidad : mecánica del sólido deformable. Madrid: Ibergarceta Publicaciones, S.L, 2019. ISBN 9788416228874.

Complementary:

- Font Mezquita, José. Tratado sobre automóviles. Valencia: Universidad Politécnica de Valencia, 2004. ISBN 9788477215011.

RESOURCES

Other resources:

In the digital campus "ATENEA"