



Course guide

310002 - 310002 - Mechanics

Last modified: 10/07/2019

Unit in charge: Barcelona School of Building Construction
Teaching unit: 748 - FIS - Department of Physics.

Degree: **Academic year:** 2020 **ECTS Credits:** 9.0
Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: ANGELINA PEÑARANDA AYLLÓN

Others: SERGIO ALONSO MUÑOZ - CARLOTA AUGUET SANGRA_ - PEDRO JUAN CASTELLVÍ GIRONÈS - ANTONIO FERNÁNDEZ - MARIA NIUBO ESLAVA - LAUREANO RAMÍREZ DE LA PISCINA MILLÁN - CECILIA SORIANO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. FB-2 Applied knowledge of the general mechanics principles, the statics of structural systems, the mass geometry, the principles and methods of analysis of the elasticity of solids.

Transversal:

2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

The learning hours of the subject alternate theoretical classes with practical classes where different exercises and problems are solved. In the theoretical classes, the faculty does a brief exposure to introduce the general learning objectives related with the basic concepts of the subject. Subsequently the faculty tries to motivate and involve the students through practical exercises. These practical classes facilitate individual aspects (concepts understanding, understanding of the wordings, specific applications, calculus methods, confidence) and collective aspects (teamwork, oral and written comprehension, variety in problem solving, question proposal). The faculty also propose exercises which can be solved at home and later explained at class.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, students should be able to:

- Use vector methods in calculations of forces and calculations of moments in systems of forces.
- Determine, in static equilibrium conditions, reactions and internal forces in rigid solid systems and statically determinate structures.
- Define the characteristic concepts about geometry of masses (gravity centre, moment of inertia, product of inertia) and calculate and use them properly.
- Appropriately interpret the tables of moments of inertia.
- Determine the inertia tensors and the main axis of inertia.
- Explain the pressure concept, the behaviour of forces in a liquid in static equilibrium and the meaning of the pressure centre. Relate this concept with systems of forces.
- Define the elastic magnitudes and interpret the meaning of the elastic modules. Use analytic methods in order to determine elastic variables.



STUDY LOAD

Type	Hours	Percentage
Self study	135,0	60.00
Hours large group	67,5	30.00
Hours medium group	22,5	10.00

Total learning time: 225 h

CONTENTS

C1 Systems of forces

Description:

Content of the lesson:

Vector definition. Fixed, displacement and free vectors. Unit vector. Cartesian components of a vector. Vector operations. Addition, difference and product with a scalar. Scalar and vector product. Strength momentum in relation to a dot and an axis. Strength systems. Invariant. Central axis. Equal systems. System reduction. Equilibrant.

Related activities:

PE1 Written problem that belongs to the continuous assessment. It includes contents 1 and 2. Carried out after completing the content 2.

ExFin and R The final exam and reappraisal include all the contents.

Full-or-part-time: 42h

Theory classes: 14h

Practical classes: 2h

Self study : 26h

C2 Analytic statics and structures

Description:

Content of the lesson:

Part 1

Newton's Laws. Statics, concepts and principles. Equilibrium concept. Degrees of freedom. Ties. Isostatic models. Free solid diagram. Static friction.

Part 2

Isostatic and jointed structures: Definition. Reaction calculus. Structure analysis with loads on knots. Resolution method by knots equilibrium. Ritter method. Beams and isostatic reticulated structures. Reaction calculus. Beam effort. External actions on a beam. Effort calculus. Equilibrium of a part of the beam. Axial, moment and shear diagrams.

Related activities:

PE1 Exercises individual test that belong to the continuous assessment. It includes the contents 1 and 2. To do after content 2.

ExFin and R The final exam and reappraisal include all the contents.

CT7.1 Independent learning level 1.

Full-or-part-time: 68h

Theory classes: 25h

Practical classes: 4h

Self study : 39h



C3 Center of mass and moment of inertia

Description:

Content:

Center of mass: concept and properties.

Center of volume mass, plain figures and material lines.

Center of mass of homogeneous and uniform figures.

First static momento. Pappus-Guldin theorem.

Moment of inertia: concept and properties. Polar inertia of surfaces. Turning radius. Steiner's theorem. Inertia product. Stress tensor. Main axes of inertia. Mohr's circle.

Related activities:

P2 Exercises individual test that belong to the continuous assessment. It includes the contents 3 and 4. To do after content 4. ExFin and R The final exam and reappraisal include all the contents.

Full-or-part-time: 40h

Theory classes: 13h 45m

Practical classes: 1h 45m

Self study : 24h 30m

C4 Static fluids and superficial phenomena

Description:

Content:

Hydrostatic. Density. Fluid Pressure. Pascal Principle. Hydrostatic equation. Archimedes principle. Strength on a dyke. Superficial tension. Capillary pressure. Contact angle. Capillary action. Jurin's Law.

Related activities:

PE2 Exercises individual test that belong to the continuous assessment. It includes the contents 3 and 4. To do after content 4. ExFin and R The final exam and reappraisal include all the contents.

Full-or-part-time: 27h

Theory classes: 8h 45m

Practical classes: 1h 15m

Self study : 17h

C5 Elasticity

Description:

Content:

Efforts and deformations. Elasticity and plasticity. Hooke's Law. Elastic modules and Poisson Ratio. Hooke's Law generalized. Lamé coefficients. Stress tensor. Principal directions of stress. Invariant of the stress tensor.

Related activities:

ExFin and R The final exam and reappraisal include all the contents.

Full-or-part-time: 48h

Theory classes: 17h 15m

Practical classes: 2h 15m

Self study : 28h 30m



ACTIVITIES

PE1 PRACTICAL TEST 1

Description:

Continuous assessment individual written test. Exercises of contents 1 and 2. Done after the end of content 2. 30% of the weighted average mark. (See qualification system).

Specific objectives:

Show the learning of contents 1 and 2.

Material:

Wording, blank paper, calculator, drawing and writing material.

Delivery:

The test is given on paper.

Full-or-part-time: 6h

Practical classes: 2h

Self study: 4h

PE2 PRACTICAL TEST 2

Description:

Continuous assessment individual written test. Exercises of contents 3 and 4. Done after the end of content 4. 20% of the weighted average mark. (See qualification system).

Specific objectives:

Show the learning of contents 3 and 4.

Material:

Wording, blank paper, calculator, drawing and writing material.

Delivery:

The test is given on paper.

Full-or-part-time: 6h

Practical classes: 2h

Self study: 4h

EXFIN FINAL EXAM

Description:

Continuous assessment individual written test. Exercises of all the contents. 50% of the weighted average mark. (See qualification system).

Specific objectives:

Students must be able to answer all the theoretical and practical questions, and to solve the exercises of the entire course.

Material:

Wording, blank paper, calculator, drawing and writing material.

Delivery:

The test is given on paper.

Full-or-part-time: 11h

Practical classes: 2h

Self study: 9h



R REAPPRAISAL

Description:

Individual written test. Exercises of all the contents.
See qualification system for details.

Specific objectives:

Students must be able to answer all the theoretical and practical questions, and to solve the exercises of the entire course.

Material:

Wording, blank paper, calculator, drawing and writing material.

Delivery:

The test is given on paper.

Full-or-part-time: 6h

Practical classes: 2h

Self study: 4h

CT7.1 LEVEL 1 SELF-LEARNING

Description:

The self-learning is about the equilibrium of the parts of a whole in equilibrium. When the concepts and the static methods have already been acquired, theoretical and practical contents are given with bibliographical references and examples that let to understand and go through the contents in a gradual way. Questions can be asked to the teachers.

Specific objectives:

Achieve the competence of level 1 self-learning.

Material:

During the preparation: available Atenea Campus connection, books, calculator, blank paper, drawing and writing material.

Delivery:

See qualification system.

Full-or-part-time: 8h

Self study: 8h

GRADING SYSTEM

There will be two practices (PE1 and PE2) and a final exam (ExFin).

The first practice PE1 includes the contents 1 and 2. The weight of the practice is a 30% of the final grade. This exercise will be done at the partial exams term.

The second practice PE2 includes the contents 3 and 4. The weight of the practice is a 20% of the final grade. This exercise will be done during the 12-13 week.

The final exam ExFin includes all the contents. The weight of this exam is a 50% of the final grade.

According to Normativa Académica de Estudios de Grado y Máster de la UPC and EPSEB, the final evaluation of the subject will be done as it is described.

The final grade of the subject will be the larger between these two grades:

a) m: Arithmetic mean of the pertinent marks of PE1, PE2 and ExFin.

$$m = 0.3p + 0.2s + 0.5f$$

where

p = PE1 practice mark.

s = PE2 practice mark.

f = ExFin final exam mark.

b) f: Final exam mark.

Reappraisal

The student who has failed the subject with a numerical mark between 3.5 and 4.9 will have the opportunity to do an unique reappraisal exam, which will include all the contents of the subject and will be done in a settled term. If the student pass the exam, his final mark of the subject will be 5.0.

The student won't be able to do this reappraisal exam if:

- i) The student has already passed the subject.
- ii) The student's final mark is less than 3.5 (including NP).

EXAMINATION RULES.

If a student has failed the subject and has not done the final exam the final grade will be NP.

BIBLIOGRAPHY

Basic:

- Beer, F.P.; Johnston, E.R.; Eisenberg, E.R. Mecánica vectorial para ingeniero, vol. 1, Estática. 8a ed. Ed. McGraw-Hill, 2007.
- Beer, F. P.; Johnston, E. R. ; DeWolf, John T. Mecánica de materiales. 4a ed. México [etc.]: Ed. McGraw-Hill, 2006. ISBN 9701061012.
- Sears, F.W.[et al.]. Física universitaria. 11a ed. Pearson Educación, 2004.
- Meriam, J.L.; Kraige, L.G. Mecánica para ingenieros : estática. 3a ed. Barcelona: Ed. Reverté, 1999.

Complementary:

- Auguet, C. E. ; Camí, E.; Peñaranda, A. Elasticidad : problemas resueltos. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1995.
- Camí, Enric. Forces i moments : teoria i problemes. Barcelona: Universitat Politècnica de Catalunya. Departament de Física Aplicada, 2000.
- Camí, Enric. Centres de gravetat: problemes resoltos. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1995.
- Agea, J.; Auguet ,C.E.; Camí, E.; Castellví , P.; Echebarría, B.; Lacasta, A.; Peñaranda, A.; Ramírez de la Piscina, L.; Rodríguez Cantalapiedra, I. Mecánica. Problemas. Enunciados y soluciones.. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona,



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- Agea, J.; Auguet ,C.E.; Camí, E.; Castellví , P.; Echebarría, B.; Lacasta, A.; Peñaranda, A.; Ramírez de la Piscina, L.; Rodríguez Cantalapiedra, I. Mecánica. Problemas de examen. Enunciados y soluciones. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 2013.

- Agea, J ; Camí, E; Castellví, P; Echebarría, B; Formosa, J; Peñaranda, A; Ramírez de la Piscina, L.. Mecànica. Exàmens resolts. 2009-2010. Grau en Enginyeria d'Edificació [on line]. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 2010 [Consultation: 07/06/2014]. Available on: <http://examens.upc.edu/curs/310002/659>.

- Auguet ,C.E.; Camí, E.; Peñaranda, A.; Rodríguez Cantalapiedra, I. Problemas resueltos de estática. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1991.

- Camí, Enric. Moments d'inèrcia i cercle de Mohr : problemes resolts. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1993.

- Carlota E. Auguet [et al.]. Tensor de inercia. Barcelona: Universitat Politècnica de Catalunya. Departament de Física Aplicada, 1989.

- Camí, Enric. Fluids : hidrostàtica, hidrodinàmica, viscositat, tensió superficial : problemes resolts. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1993.

RESOURCES

Other resources:

Audiovisual Material

·DVD Humitats per capil·laritat

Rodríguez Cantalapiedra, I.; Lacasta, A; Sarró, P.