



Course guide

310702 - 310702 - Mechanics

Last modified: 06/06/2024

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

Degree: BACHELOR'S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019).
(Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: CARLOTA E. AUGUET SANGRÀ

Others: Sergio Alonso
Eduardo Moreno
M^a. Luisa Perea
Oscar Lorente-Espín

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 participative 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 proposes exercises which can be solved at home and later explained or resolved 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
Hours large group	30,0	20.00
Hours medium group	9,0	6.00
Hours small group	21,0	14.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

C1 Systems of forces

Description:

Newton's Laws and force concept. Strength applied to a rigid solid. Strength moment given a certain point. Strength moment given a axis. Moment theorem. Force systems. Equivalent systems. Reduction of a force system. Particular cases: torque, systems of concurrent, parallel and coplanar forces.

Full-or-part-time: 30h 10m

Theory classes: 3h

Practical classes: 7h

Self study : 20h 10m

C2 Analytic statics and structures

Description:

2.1. Statics. Equilibrium concept. Degrees of freedom. Ligation. Isostatic system. Free solid diagram. Friction. Systems of several solids in equilibrium: external, internal and altogether equilibrium.

2.2. Isostatic articulated structures. Reaction calculations. Node method. Ritter method or sections method.

2.3. Beams. Gathered and distributed loads. Cutting efforts and bending moment. Equilibrium of a flat slice. Cutting effort's diagrams. Bending moment's diagrams.

Full-or-part-time: 46h 50m

Theory classes: 3h

Practical classes: 15h

Self study : 28h 50m

C3 Center of mass and moment of inertia

Description:

3.1. Mass center: concept and features. Center of gravity of volumes, flat figures and material lines. Center of gravity of flat homogeneous figures: static moment of first order. Pappus-Guldung theorem.

3.2. Moment of inertia: concept and features. Moment of inertia of flat surfaces: static moment of second order. Turning radius. Steiner's theorem. Product of inertia. Inertia tensor. Main axes and moments of inertia.

3.3. Applications: retaining wall, bending of beams.

Full-or-part-time: 37h 10m

Theory classes: 6h

Practical classes: 12h

Self study : 19h 10m



C4 Elasticity

Description:

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

Full-or-part-time: 35h 50m

Theory classes: 6h

Practical classes: 8h

Self study : 21h 50m

ACTIVITIES

PE2 PRACTICAL TEST 2

Description:

Continuous assessment individual written test. Exercises of contents of second half part of the subject. Done at the end of the period.

25% of the weighted average mark. (See qualification system).

Specific objectives:

Show the learning of contents of the second half part of the subject

Material:

Statement, blank paper, scientific calculator, drawing and writing material.

Delivery:

The test should be turned in on paper.

Full-or-part-time: 6h

Self study: 4h

Practical classes: 2h

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:

Statement, blank paper, scientific calculator, drawing and writing material.

Delivery:

The test should be turned in on paper.

Full-or-part-time: 11h

Self study: 9h

Practical classes: 2h



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:

Statement, blank paper, scientific calculator, drawing and writing material.

Delivery:

The test should be turned in on paper.

Full-or-part-time: 6h

Self study: 4h

Practical classes: 2h

name english

Description:

Continuous assessment individual written test. Exercises of contents of second half part of the subject. Done at the end of the period.
25% of the weighted average mark. (See qualification system).

Specific objectives:

Show the learning of contents of the firsthalf part of the subject

Material:

Statement, blank paper, scientific calculator, drawing and writing material.

Delivery:

The test should be turned in on paper

Full-or-part-time: 6h

Self study: 4h

Practical classes: 2h

GRADING SYSTEM

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

The first practice PE1 includes the first half part of the matter. 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 second half part of the matter, except the last subject. The weight of the practice is a 20% of the final grade. This exercise will be done at the end of the period.

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.

$$m = 0.30p + 0.20s + 0.5f$$

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.
- Mobiles are not allowed during the exam.
- The entry to the exam will be denied once started.

BIBLIOGRAPHY

Basic:

- 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.
- 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.

Complementary:

- 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, 2013.
- 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 resultats. 2009-2010. Grau en Enginyeria d'Edificació [on line]. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 2010



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- Auguet ,C.E.; Camí, E.; Peñaranda, A.; Rodríguez Cantalapiedra, I. Problemas resueltos de estática. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1991.
- Auguet, C. E. ; Camí, E.; Peñaranda, A. Elasticidad : problemas resueltos. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1995.
- Carlota E. Auguet [et al.]. Tensor de inercia. Barcelona: Universitat Politècnica de Catalunya. Departament de Física Aplicada, 1989.
- Camí, Enric. Forces i moments : teoria i problemes. Barcelona: Universitat Politècnica de Catalunya. Departament de Física Aplicada, 2000.
- Camí, Enric. Centres de gravetat: problemes resolts. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1995.
- Camí, Enric. Moments d'inèrcia i cercle de Mohr : problemes resolts. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1993.
- 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.