Course guide
240063 - 240063 - Strength of Materials

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer: MIQUEL CASAFONT RIBERA

Others: Jordi Bonada Bo
Miquel Casafont Ribera
Agustín Gómez Saez
Xavier Centelles Soler
Jordi Fábrega Freixas
Jordi Guilera Domingo
Romà Suñé Lago

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge and capacities to apply fundaments of materials' elasticity and resistance to the behaviour of real solids.

TEACHING METHODOLOGY

Lessons combining theory and problems: a subject is explained and then problems related to the subject are presented and solved. Every week several exercises are proposed to be solved by each student at home, and the solution is presented in the following week. The exercises are corrected iin the classroom, revised by the professor and returned to each student.
Each student does 4 practices in the laboratory (of 2 h), and a team work (teams of 3 students), that consists of designing, analyzing, building and testing a structural element (a multisectiom, non stright beam).

LEARNING OBJECTIVES OF THE SUBJECT

- To determine internal forces in prismatic beams, in the plane and in the space
- To verify strength and stiffness of prismatic beams
- To decide the type of section and its dimensions for prismatic beams subjected to static loading
- To analyse elementery types of statically indeterminate pieces
- To verify the buckling behaviour of beams subjected to pure compression.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Guided activities	3,4	2.27
Hours large group	50,0	33.33
Hours small group	6,6	4.40

Total learning time: 150 h

CONTENTS

1. Prismatic beam

Description:
The prismatic beam. Links and actions. Method of sections. Diagrams of internal forces.

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

2. Axial and shear forces

Description:
Axial force. Plane frame structures.Shear, Design of rivets, bolts and pins.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

3. Bending moment

Description:
Pure bending: Navier hypothesis. Asymmetrical bending. Bending moment and axial force.

Full-or-part-time: 17h
Theory classes: 8h
Self study : 9h

4. Shear force

Description:
general theory of the shear stresses.Compact sections:Collignon theory. Thin walled sections. Bending moment and shear force: generalized Navier theory. Composite sections.

Full-or-part-time: 19h
Theory classes: 8h
Self study : 11h

5. Torsion

Description:
Circular sections: Coulomb theory. Saint-Venant theory: application to rectangular sections. Thin walled sections: Bredt formulae. Bending moment, shear force and torsion combined.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

6. Deflections in beams

Description:
Energy theorems and methods.Double integration method. Moment area method.

Full-or-part-time: 14h
Theory classes: 6h
Self study : 8h

7. Statically indetermined beams

Description:
Straight beams of one and several spans. Systems with several beams.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

8. Buckling of columns

Description:
Buckling of straight columns. Euler's formula. Design of columns subjected to buckling.

Full-or-part-time: 5h
Theory classes: 2h
Self study : 3h

Laboratory practices

Description:
Practice 1: STRAIN GAGES.
Analysis, by means of strain gages, of beams subjected to uniaxial traction, biaxial traction and bending.
Practice 2. FINITE ELEMENT METHOD.
Analysis of beams by means of finite elements models.
Practice 3. ASYMMETRICAL BENDING.
Analysis of the bending behaviour of a section in non principal axes of inertia.
Practice 4. TESTING OF A BEAM.
Strenght and stifness experimental analysis of a beam build by the student.

Full-or-part-time: 10h
Laboratory classes: 8h
Self study : 2h

Work

Description:
The work is done by a team of 3 students. It consists in designing, calculating, building and testing (Practice 4 in the Laboratory) a beam.

Full-or-part-time: 15h
Self study : 15h

GRADING SYSTEM

Nota Final= 0,2 NT + 0,6 NE + 0,2 NLT

NT: Mark from the Test, obtained in the Test that is done in the middle of the semester
NE: Mark from the Final Exam, mark obtained as mean from all the parts of the exam
NL: Mark from the practical sessions in the Lab and course project.

Reevaluation: The Mark of the Reevaluation Exam (NER) substitutes the Mark of the Final Exam (NE)

In the event of confinement during the first term of the 2020-2021 course, the method of assessment will be
- the formula for calculating the final mark is the same
- the only differences are those motivated by distance-learning:
+ Theory-Problem lectures will be online, each group with its professor, within the scheduled time
+ The lab programme will be adapted to distance learning.
+ The assignment will be adapted to replace the experimental part by a numerical simulation part.
+ The Midterm and Final Exams will be online.

EXAMINATION RULES.

- In the Midterm Test and in the part of theory of the Final Exam and the Revaluation exam, nomaterial can be used.
- In the part of problems in the Final Exam only the official formular can be used (1 sheet DIN A4)
- In the Test, in the Final Exam and in the Reevaluation Exam only a non-programmable calculator can be used

BIBLIOGRAPHY

Basic:
- Roure, Francesc; Frederic Marimon ; Xavier Ayneto. Resistencia de Materiales (Fascicles 1 a 8). Barcelona: Copistería Imatge, 2012.
- Ayneto, Xavier ; Marimon, Frederic ; Pastor, M.Magcdalena ; Roure, Francesc. Enunciats de problemes amb solucions. Barcelona: Copisteria Imatge, 2012.
- Ferrer, M. Resistencia de materiales: problemas resueltos [on line]. 2a ed. Barcelona: Edicions UPC, 2002 [Consultation: 09/09/2022]. Available on: https://upcommons.upc.edu/handle/2099.3/36450. ISBN 8483016214.
- Marimon, Frederic ; Pastor, M. Magdalena ; Roure, Francesc ; Sanz, Jesús. Elasticitat i Resitència de Materials: Pràctiques de Laboratori. Barcelona: Copisteria Imatge, 2013.

Complementary:
- Ortiz Berrocal, Luis. Resistencia de Materiales [on line]. 3a. Madrid: Mc Graw-Hill, 2007 [Consultation: 08/09/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3962. ISBN 9788448156336.
- Gere, James M. Mecánica de Materiales. 7a. México: Cengage, 2009. ISBN 9789708300407.
- Courbon, Jean. Tratado de Resistencia de Materiales. Vol. 1. 2a. Madrid: Aguilar, 1968.
- Fornons, J. M. El Método de los Elementos Finitos en la Ingeniería de Estructuras. Barcelona: Marcombo-Boixareu, 1982. ISBN 8460026477.
- Tablas de Elasticidad y Resistencia de Materiales. Barcelona: Copisteria Imatge, 2012.

RESOURCES

Computer material:
- PRISMATIC 1.0 (http://www.upc.edu/demormee/index.htm). Multimedia material to support self learning, accessible through Internet. Contents: resumed theory, solved problems and problems to de resolved