



Universidad de Jaén

School of Engineering of Jaén

Elasticity and strength of materials

2023-2024

Grado en Ingeniería de organización industrial

Doble Grado en Ingeniería mecánica e Ingeniería de organización industrial

Grado en Ingeniería electrónica industrial

Grado en Ingeniería eléctrica

Doble Grado en Ingeniería eléctrica e Ingeniería electrónica industrial

Doble Grado en Ingeniería mecánica e Ingeniería electrónica industrial

Doble Grado en Ingeniería eléctrica e Ingeniería mecánica

Grado en Ingeniería mecánica

CREA



Guías docentes UJA

Horarios de tutorías

Llamamientos PEvAU

Syllabus 2023-24 - 13512008 - Elasticity and strength of materials (Elasticidad y resistencia de materiales)

Caption

- Level 1: Tutorial support sessions, materials and exams in this language
- Level 2: Tutorial support sessions, materials, exams and seminars in this language
- Level 3: Tutorial support sessions, materials, exams, seminars and regular lectures in this language

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Full version (Spanish)

English

DEGREE:	Grado en Ingeniería eléctrica (13512008)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Doble grado en Ingeniería eléctrica e Ingeniería mecánica (13612009)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Grado en Ingeniería de organización industrial (13012005)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Doble grado en Ingeniería eléctrica e Ingeniería electrónica industrial (13712010)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Grado en Ingeniería electrónica industrial (13112006)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Doble Grado en Ingeniería mecánica e Ingeniería electrónica industrial (13912008)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Grado en Ingeniería mecánica (13412006)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
DEGREE:	Doble grado en Ingeniería mecánica e Ingeniería de organización industrial (13812007)
FACULTY:	SCHOOL OF ENGINEERING OF JAÉN
ACADEMIC YEAR:	2023-24
COURSE:	Elasticity and strength of materials

SYLLABUS

1. COURSE BASIC INFORMATION

NAME: Elasticity and strength of materials	ACADEMIC YEAR: 2023-24
CODE: 13512008 (*)	LEVEL: 2
LANGUAGE: English	ECTS CREDITS: 6.0
YEAR: 2	SEMESTER: SC

2. LECTURER BASIC INFORMATION

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NAME: MUÑOZ HERVÁS, JOSÉ CARLOS		
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OFFICE NO.: -

E-MAIL: -

P: -

WEBSITE: -

ORCID: -

LANGUAGE: -

LEVEL: 2

3. CONTENT DESCRIPTION

Block A: THEORY OF ELASTICITY

LESSON I.- INTRODUCTION TO ELASTICITY

Introduction to the mechanics of continuous media.
The elastic solid. Properties. .
Hypothesis and principles of elasticity.

LESSON II.- Stress

The stress concept.
Conditions of equilibrium.
Principal stresses. Invariant properties.
Plane Stress.
Graphic representation of stresses. Mohr's circles.

LESSON III.-Strain.

Changes of volume and shape.
The strain concept.
The strain matrix. Properties.
Compatibility equations.
Plane Strain.

LESSON IV.- Stress- strain relationship.

The tensile test.
Lateral strain. Poisson's coefficient.
Stress-strain relationship. Hooke's law.
Lame's equations.

LESSON V.- The Energy approach of elasticity.

Strain energy.
Strain energy expressions.
Castigliano's theorem.
Yielding criteria. von Mises's stress.

LESSON VI.- Thin-walled Vessels

Thin-walled Vessels.
Cylindrical and Spherical vessels subjected to internal pressure.
Cylindrical open liquid tanks.
Cylindrical pipes subjected to pressure.

Block B: Strength of Materials

LESSON VII.- Basic Concepts of Strength of Materials.

Structural members.
Cross Section stresses. Definitions.
General principles of strength of materials.
External and cross section equilibrium.
Types of supports. Support reactions.
Isostatic and hyperstatic bars.

LESSON VIII.- Tension and Compression.

Stress by uniaxial tension or compression.
Axial force laws and diagrams.
Deformation due to axial force.
Tension or compression produced by own weight of members
Strain energy related to axial force.

LESSON IX.- General Theory of Bending.

Simple Bending. Navier's law.
Relationship between shear force and bending moment.
Bending moment and shear force laws and diagrams.
The ten elemental beams analysis.
Stress produced by shear force. Collignon's theorem.
Principal stresses and von Mises's stress in bending.

LESSON X.- Deflection produced by bending.

Differential equation of the bend line.
The double integration method.
Mohr's theorems in bending.
Strain energy related to simple bending.
Deflection produced by shear force.

LESSON XI.- Biaxial Bending with and without axial force.

Biaxial bending. Neutral axis.
Deflection produced by biaxial bending.
Bending with axial force or eccentric tension/compression. Pressure centre.
Neutral Axis and Kernel in biaxial bending with axial force.

LESSON XII.- Buckling.

Stability of Columns.
Euler's formula.
Buckling Critical Load according to end conditions.

LESSON XIII.- Torsion.

Pure Torsion. Circular shaft subjected to torsion.
Determination of torque.
Strain energy related to torque.

Practices (the student will take each year 5 out of 8)

Practice 1: Solving problems of Elasticity using MATLAB.

Practice 2: Analysis of Stress and Strain in cylindrical vessels subject to inner pressure.

Practice 3: Electric Extensometry: Tension/Compression. Torsion and Bending.

Practice 4: Numerical analysis of stress in beams using software

Practice 5: Bending. Experimental determination of the bend line. Principle of superposition in bending.

Practice 6: Analysis of biaxial bending and axial force using computational software.

Practice 7: Biaxial bending with axial force.

Practice 8: Buckling. Critical load according to end conditions.

4. COURSE DESCRIPTION AND TEACHING METHODOLOGY

LECTURES

During the lectures, the different sections included in the course's syllabus will be developed. Student participation may take place at any time and doubts will be solved at the time. During lectures the problems of the course included in the collections of problems will be solved in a participatory way and discussion of results and resolution methods will be exposed. Selected exercises and practical cases will be solved at the end of each chapter, along with some exams problems.

To complement the learning process, the student will have at hand notes and slides with some of the content of classes. Additionally, collections of problems and previous exams will be also available.

For selected lessons, an approach of flipped classroom might be followed, whereby the students would prepare the lesson initially, with help of the support material provided by the teacher. After that, some practical problems would be tackled at class to consolidate the learning process.

LAB SESSIONS

Practices will be held in the laboratory of the area of mechanics of continuous media and theory of structures or in computers room. Lab session will be divided in two parts: first, there will be a theoretical introduction along with some exhibition, where the teacher will explain the tasks to be performed using lab equipment or computational scripts; then, student must work on their own and collect data to elaborate a final report, to be submitted after a few days.

Notes concerning the lab sessions will be available beforehand at the web site of the course. The content of such notes is considered selfcontained, and will allow the student to learn about the theoretical aspects and practical exercises and equipment before going to the lab.

SEMINARS

Additional tutor hours and seminars may be organized to present practical applications of the theoretical contents of lessons.

STUDENT CENTERED LEARNING

Additionally, based on the student centered learning approach and within the pilot program supported by the project NextGEng, a tutorial seminar can be proposed in which a complementary lecture lead by a foreign teacher of the same course will be presented in English. The goal of this seminar is to guide students in the learning process, as an on-going reflexive process, based on their different needs, interests and learning styles.

PROJECT BASED LEARNING

As a complement to the guided learning process, a group directed activity is proposed as a project-based learning experience. This activity consists of a project to be carried out in a directed manner throughout the course; and it is supervised with the planning of seminars or collective tutorials contemplated in the teaching guide as well. In this sense, the activity seeks: 1) the analysis of a new problem using different techniques: information search, experimental planning, conducting experiments, analysis of experimental data and theoretical analysis; allowing to delve into a particular subject of Elasticity and Strength of Materials. 2) Promote the habits of associating ideas, finding and using sources, and establishing one's own criteria, gradually solving the difficulties raised.

OTHER INFORMATION

Students with special educational needs should contact the Student Attention Service (Servicio de Atención y Ayudas al Estudiante) in order to receive the appropriate academic support.

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5. ASSESSMENT METHODOLOGY

At the final exam, the score of both theoretical and operating contents of course must be greater than zero in each of part, to pass the exam.

In particular, the theoretical contents' weight in the final exam is 30%, while the remaining 70% concerns operational exercises (problems)

Additionally, the student is required to pass independently both final exam and lab sessions, in order to pass the course. The learning process associated to the lab sessions will be evaluated by means of a virtual test at the end of each session, which will ask about content and practical tasks performed by the student at the practices. Additionally, the student will have to turn in the files containing calculations and notes from the lab sessions.

In an attempt to evaluate the continuous progress of the student's learning process, weekly One Minute papers activities and kahoot tests are planned as a class activity. Besides, guided practical group activity will be also proposed to complement laboratory tasks.

6. BOOKLIST

MAIN BOOKLIST:

- Advanced mechanics of materials and applied elasticity . Edition: 6th. ed.. Author: Ugural, A. C.. Publisher: Pearson ([Library](#))

ADDITIONAL BOOKLIST:

- Mechanics of materials . Edition: 9th ed., SI ed.. Author: Hibbeler, Russell C.. Publisher: Pearson Education ([Library](#))

7. VIRTUAL / CLASSROOM TEACHING SCENARIO

Teaching activities	Format (on-site/online)*	Teaching methodology Description
A1 - Lectures	On-site 50%	Lectures as scheduled at the classroom assigned to a part of the group and retransmission by video conferencing to the rest, with rotation student periodic, as determined by the Center. There will be 2 weekly sessions of 2 and 1 hours respectively. In these sessions the teacher explains and explains the concepts corresponding to the contents of the subject, and solves exercises related to the subject studied. Students will have supplementary material in Virtual Teaching, although the classes will rigorously follow the content of the basic book of the subject.
A2- LAB SESSIONS	On site 100%	Lectures as scheduled at the classroom assigned to a part of the group. 2-hour sessions will take place. The practices will be in the laboratory of continuous media mechanics and structure theory or in computer classrooms. They will have two parts, an exhibition, where the teacher will explain the tasks to be performed and a part of the work of the students in groups on the laboratory equipment. The scripts will be facilitated prior to the realization of the practice in the Virtual Teaching platform.
A3R- Seminars	On site (50%) / Online	In a complementary way, group tutorials or seminars can be planned to strengthen and expand the concepts of Elasticity and Strength of Materials, and pose applied problems; clarifying doubts. They will consist of face-to-face

		sessions (small groups of 50%, retransmission and rotation of students), each lasting one hour. Also, this activity can be replaced by forums or synchronous tutorials by GSuite Meet.
A3-Tutor hours	Online	Tutoring will be provided online through GSuite Meet

Ordinary call

Assesment	Format (face-to-face / online synchronous or asynchronous)	Description	Percentage
Written test	On-site	Domain of theoretical content and practical	50%
Laboratory computer practice report.	Face-to-face / synchronous and asynchronous online	Quiz and delivery of practice reports. Structure of the Report. Quality of Documentation and Presentation	25%
Practical activities	Asynchronous online	Resolution of practical cases and application exercises	25%

Extraordinary call

Assesment	Format (face-to-face / online synchronous or asynchronous)	Description	Percentage
Written test	On-site	Domain of theoretical content and practical	50%
Laboratory computer practice report.	Face-to-face / synchronous and asynchronous online	Quiz and delivery of practice reports. Structure of the Report. Quality of Documentation and Presentation	25%
Practical activities	Asynchronous online	Resolution of practical cases and application exercises	25%

NOTE: To pass the subject it will be necessary to pass independently both the Exam and the Practices. On the other hand, in the theoretical examination it will be necessary to score both theoretical and operational content of the subject, having a rating greater than zero in each of these parts. The weight of the theoretical contents in the exam will be 30% versus 70% of operational content (problems).

Resources

The following shall be used as synchronous tools:

- Tutorials by videoconference using Google Meet.

As asynchronous tools the following shall be used:

- Presentations and solved exercises available in the virtual teaching platform.
- Scripts of practices provided in the virtual teaching platform.
- Consultation of doubts and tutor hours using the virtual teaching platform.

In the multimodal and / or non-face-to-face scenario, when appropriate, the staff involved in teaching, reserves the right not to consent to the capture, publication, retransmission or reproduction of their speech, image, voice and explanations of chair, in the exercise of his teaching functions, in the field of the University of Jaén.

8. VIRTUAL TEACHING SCENARIO

Teaching activities	Format (on-site/online)*	Teaching methodology Description
A1 Lectures	online	There will be 2 weekly sessions of 2 and 1 hours respectively. Classes will consist of synchronous online classes through GSuite Meet, with duration equal to the number of hours of classroom teaching of the subject. The videos may be recorded and provided through the platform of the subject. In these videos, the professor exposes and explains the concepts corresponding to the contents of the subject, and exercises related to the studied subject are solved.
A2 LAB SESSIONS	online	2-hour sessions will be held. Synchronous practice sessions will be held synchronously in GMeet, and will be recorded and uploaded in the virtual teaching platform. They will have two parts, an expository, where the teacher will explain the tasks to be carried out and a part of group work of the students on the laboratory equipment.

		The scripts will be provided prior to completing the practice in Virtual Teaching.
A3R Seminars	Online	In a complementary way, group tutorials or seminars can be planned to strengthen and expand the concepts of Elasticity and Strength of Materials, and pose applied problems; clarifying doubts. They will consist of one-hour synchronous video conference sessions on GSuite Meet.
A3 Tutor hours	Online	The tutorials will be carried out online in synchronous mode using GSuite Meet.

Ordinary call

Assesment	Format (face-to-face / online synchronous or asynchronous)	Description	Percentage
Written test	Synchronous online	Domain of theoretical content and practical	50%
Laboratory computer practice report.	Synchronous online	Delivery of practice reports. Structure of the Report. Quality of Documentation and Presentation	25%
Practical activities	Synchronous online	Resolution of practical cases and application exercises	25%

Extraordinary call

Assesment	Format (face-to-face / online synchronous or asynchronous)	Description	Percentage
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DATA PROTECTION CLAUSE (on line exams)

Institution in charge of data processing: Universidad de Jaén, Campus Las Lagunillas, s/n, 23071 Jaén

Data Protection Delegate: dpo@ujaen.es

Purpose: In accordance with the Universities Law and other national and regional regulations in force, carrying out exams and assessment tests corresponding to the courses students are registered in. In order to avoid frauds while sitting the exam, the exam will be answered using a videoconference system, being able the academic staff of the University of Jaén to compare and contrast the image of the person who is answering the exam with the student's photographic files. Likewise, in order to provide the exam with evidential content for revisions or claims, in accordance with current regulation frameworks, the exam will be recorded and stored.

Legitimacy: compliance with legal obligations (Universities Law) and other national and regional regulations currently in force.

Addressees: service providers who are the owners of the platforms where the exams are carried out and with whom the University of Jaén has signed the corresponding data access contracts.

Storage periods: those established in current in force regulations. In the specific case of exam videoconference recordings, not before the examination records and transcripts are closed or the exam can still be reviewed or challenged.

Rights: you can exercise your right of access, amendment, cancellation, opposition, suppression, limitation and portability by sending a letter to the postal or electronic address indicated above. In the event that you consider that your rights have been violated, you may submit a complaint to the Andalusian Council for Transparency and Data Protection www.ctpdandalucia.es

CLASS RECORDING CLAUSE PERSONAL DATA PROTECTION

Person in charge: Universidad de Jaén, Paraje Las Lagunillas, s/n; Tel.953 212121; www.ujaen.es

Data protection delegate (DPO): TELEFÓNICA, S.A.U. ; Email: dpo@ujaen.es

Procedure aim: To manage proper recordings of teaching sessions with the aim of facilitating learning process under a multimodal and/or online teaching

Period for record storage: Images will be kept during legal term according to regulations in force

Legitimacy: Data will be managed according to legal regulations (Organic Law 6/2001, December 21, on Universities) and given consent provided by selecting corresponding box in legal admission documents

Data recipients (transfers or assignments): Any person allowed to get access to every teaching modality

Rights: You may exercise your rights of access, rectification, cancellation, portability, limitation of processing, deletion or, where appropriate, opposition. To exercise these rights, you must submit a written request to the Information, Registration and Electronic Administration Service of the University of Jaen at the address above, or by e-mail to the address above. You must specify which of these rights you are requesting to be satisfied and, at the same time, you must attach a photocopy of your ID card or equivalent identification document. In case you act through a representative, legal or voluntary, you must also provide a document that proves this representation and identification. Likewise, if you consider that your right to personal data protection has been violated, you may file a complaint with the Andalusian Data Protection and Transparency Council www.ctpdandalucia.es