

Course guide

220016 - M - Mechanics

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

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

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: JORDI ROMEU GARBI

Others: JORDI PALMIOLA CREUS - TERESA PAMIES GOMEZ - ANDREU BALASTEGUI - BEATRIZ PURAS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

2. GrETA/GrEVA - Applied knowledge of materials science and technology; mechanics and thermodynamics; fluid mechanics; aerodynamics and flight mechanics; navigation systems and air traffic; aerospace technology; structural theory; economy and production; projects; environmental impact.

Transversal:

1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

Basic:

CB05. That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

TEACHING METHODOLOGY

The educational methodology is divided into four parts:

- Presencial sessions of contents exhibition
- Presencial sessions of practical work
- Autonomous work of study and realization of exercises and activities

In the content exhibition sessions the teaching staff will introduce the theory bases of the subject, methods, concepts and results with examples of engineer character to facilitate their understanding.

The teaching staff will guide students in the application of the theory concepts for solve problems related with industrial engineering in the sessions of practical work in the classroom. It will purpose exercises which students have to solve in the classroom with partners and the teacher, or out of the classroom, in order to learn the utilization of tools for solving problems.

The autonomous work will consist on problems and conceptual questions which are proposed in the bibliography. They will develop everything what has been seen in the presencial sessions of content exhibition and practical work.

LEARNING OBJECTIVES OF THE SUBJECT

The subject introduces to student in applied knowledge of the mechanics and in the concepts and principles which determine the behaviour of the structures with dynamic solicitations on duty.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	14,0	12.44
Hours large group	31,0	27.56
Self study	67,5	60.00

Total learning time: 112.5 h

CONTENTS

-1.1 Particle kinematics

Description:

Reference and base
Intrinsic components
Composition of movements

Specific objectives:

Recovery of concepts seen in previous subjects.

Related activities:

1,2,3

Full-or-part-time: 7h

Theory classes: 2h
Practical classes: 1h
Self study : 4h

-1.2 Rigid Solid Movements

Description:

Degrees of freedom
Movements of the solid: rotation and translation
Properties of the movement
Instantaneous axis of rotation

Specific objectives:

Understand the motion of solids in space and apply the concepts and expressions typical of this topic to solving problems of motion of solids and systems of solids in space.

Related activities:

1,2,3

Full-or-part-time: 18h 30m

Theory classes: 4h
Practical classes: 2h
Self study : 12h 30m

-1.3 Solids in contact

Description:

Contact point
Relative motion
Succession rate
Speed \vec{v} and acceleration of the point of contact

Specific objectives:

Understand the movement of solids in contact. Apply the expressions and concepts related to the motion of two solids in contact to solve problems.

Related activities:

1,2,3

Full-or-part-time: 20h

Theory classes: 6h
Practical classes: 2h
Self study : 12h

-1.4 Flat kinematics

Description:

Simplification of the kinematics of space to plane motion.

Specific objectives:

Solving problems of plane kinematics.

Related activities:

Simplification of the kinematics of space to plane motion.

Full-or-part-time: 16h

Theory classes: 4h
Practical classes: 2h
Self study : 10h

-1.5 Particle dynamics

Description:

Newton Laws
Inertial and non-inertial references
Moment of a force

Specific objectives:

Recover concepts seen in other previous subjects in the area of \vec{v} Physics.

Full-or-part-time: 5h

Theory classes: 2h
Practical classes: 1h
Self study : 2h

-1.6 Theorems of dynamics

Description:

The Quantity of Motion Theorem
Kinetic Moment Theorem
Kinetic Energy Theorem

Specific objectives:

Determine the relationship between the applied forces and the kinematic magnitudes. Learn to work with a particle system.

Full-or-part-time: 7h

Theory classes: 2h
Practical classes: 1h
Self study : 4h

-1.7 Inertia

Description:

Definition and properties of moments of inertia
Product of inertia
Inertia matrix
Steiner's theorem
Directions and main moments of inertia
Symmetry considerations

Specific objectives:

Learn to calculate the inertia matrix of a solid

Full-or-part-time: 5h

Theory classes: 2h
Practical classes: 1h
Self study : 2h

-1.8 Dynamics of the solid

Description:

The Quantity of theorem of motion
Kinetic Moment Theorem
Kinetic Energy Theorem
Conditions of connection

Specific objectives:

Determination of the equations of motion of a solid or system of solids

Full-or-part-time: 18h

Theory classes: 5h
Practical classes: 2h
Self study : 11h

-1.9 Flat dynamics

Description:

Simplification of the equations of space motion in the plane case

Specific objectives:

Resolution of the dynamics of flat mechanisms

Related activities:

Simplification of the kinematics of space to plane motion

Full-or-part-time: 16h

Theory classes: 4h

Practical classes: 2h

Self study : 10h

ACTIVITIES

SESSIONS IN LARGE GROUPS

Description:

Preparation before and after the sessions and attendance at the sessions

Specific objectives:

Establish the theoretical principles of the subject

Transfer theoretical principles to solving practical engineering cases

Approach engineering problems systematically.

Formulate hypotheses based on theoretical expressions

Material:

Notes on the Athena platform

General bibliography of the subject

Delivery:

Resolution of exercises in class or autonomously that will be part of the 20% of the mark of ordinary activities

Full-or-part-time: 42h

Theory classes: 28h

Self study: 14h

MEDIUM GROUP SESSIONS

Description:

Individual or group resolution of problems of the subject

Specific objectives:

Solve problems related to the dynamics of solids systems

Material:

General bibliography of the subject

Delivery:

Resolution of exercises in class that will be part of the 20% of the mark of ordinary activities

Full-or-part-time: 21h

Practical classes: 14h

Self study: 7h



PARTIAL EXAMINATION

Description:

Individual and written test of the contents of kinematics

Specific objectives:

The test must show that the student has acquired the necessary knowledge of kinematics of the rigid solid.

Material:

Statement of the partial test

Delivery:

Resolution of the test. 30% of the final grade

Full-or-part-time: 24h 10m

Theory classes: 1h

Self study: 23h 10m

FINAL EXAM

Description:

Individual and written test of all the content of the subject

Specific objectives:

The test must show that the student has acquired the necessary knowledge of the dynamics and kinematics of the rigid solid.

Material:

Statement of the final test

Delivery:

Resolution of the test. 50% of the final grade

Full-or-part-time: 25h 20m

Theory classes: 2h

Self study: 23h 20m

GRADING SYSTEM

- Partial examination: 30%
- Final exam: 50%
- Ordinary activities of class (partial): 10%
- Ordinary activities of class (final): 10%

All those students who cannot attend the partial examination or who not pass it, will have the option to recover the note by taking the final exam of the subject. The passing of the final exam with a grade equal to or higher than 5 replaces the partial exam grade with a 5 point qualification.

EXAMINATION RULES.

The partial and final examination will be individual without material support (notes or books).

The ordinary activities will develop in groups with other classmates and teacher but without material support.



BIBLIOGRAPHY

Basic:

- Capdevila Pagés, Ramón [et al.]. Cinemática. 2a ed. Barcelona: Edicions UPC, 2001. ISBN 8483014696.
- Capdevila Pagés, Ramón [et al.]. Dinámica. Barcelona: Edicions UPC, 1993. ISBN 8476532830.
- Capdevila Pagés, Ramón [et al.]. Mecánica: problemas [on line]. Barcelona: Edicions UPC, 2004 [Consultation: 19/05/2020]. Available on: <http://hdl.handle.net/2099.3/36624>. ISBN 8483017806.

Complementary:

- Meriam, J. L.; Kraige, L.G. Mecánica para ingenieros. Vol. 2, Dinámica [on line]. 3a ed. Barcelona: Reverté, 1998-1999 [Consultation: 20/09/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635460>. ISBN 8429142592.

RESOURCES

Audiovisual material:

- Apunts de Mecànica

Other resources:

Notes of the subject