Course guide
340073 - MECA-D3O12 - Mechanics

Unit in charge:	Vilanova i la Geltrú School of Engineering
Teaching unit:	712 - EM - Department of Mechanical Engineering.
	729 - MF - Department of Fluid Mechanics.
Degree:	BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).

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

LECTURER

Coordinating lecturer:	INGRID MAGNUSSON MORER
Others:	Escola Fernandez, Marc
	Nápoles Alberro, Amelia Emelina

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. D1. Knowledge of fundamental principals of mechanics of solids rigids and its application of resolving problems concerning engineering (CINEMATICA, statics, dynamics)
2. D2. Ability to define conditions and functions of pneumatic and hydraulic systems applicable to machines and mechanic systems.
3. D3. Ability to draw up proposals of pneumatic and hydraulic system configurations.

Transversal:
4. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

There are two types of face-to-face sessions: the sessions that take place in the theory classroom, in large groups, and the sessions that take place in the mechanics laboratory, in small groups.
The large group sessions integrate the exposition of the basic theoretical concepts of the thematic contents of the subject and applied examples are described in the form of exercises. The teacher presents exercises of application of the concepts studied and proposes others to be resolved by the student, individually or in groups.
In the small group sessions that take place in the laboratory, the mobility of some mechanisms is experimented. A group work is carried out that puts into practice, on a specific mechanism, most of the concepts introduced in the theory sessions. This work lasts the entire course, and is supervised and scheduled in periodic deliveries.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student should be able to:

- Analyze and relate sollicitations, efforts and movements in mechanical systems.
- Knowledge of hydraulic and pneumatic components, and symbols of representation for the interpretation of hydraulic and pneumatic circuits.
- Size and select the different pneumatic and hydraulic components.
- Simulate the behavior of a pneumatic and hydraulic circuit using a simulation program.
- Decide what time is used for each task from a time guideline.
- Work with the sources of information that the teacher tells you and with which he or she expands.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	9.26
Hours large group	45,0	27.78
Self study	102,0	62.96

Total learning time: 162 h

CONTENTS

1- Mobility of mechanisms

Description:
1.1 Basic definitions in machines theory
1.2 Members and kinematic links
1.3 Types of mechanisms
1.4 Kinematic scheme of a mechanism
1.5 Degrees of freedom of a mechanism
1.6 Position study of a mechanism (with trinagles geometry)

Full-or-part-time: 12h
Theory classes: 3h
Laboratory classes: 2h
Self study : 7h

2- Equivalent forces systems

Description:
2.1 Basic concepts and definitions
2.2 Vectorial operations and trigonometry
2.3 Moment of a forcé
2.4 Equivalent systems of forces

Full-or-part-time: 10h
Theory classes: 5h
Self study : 5h

3- Mass geometry

Description:
Location of the centre of gravity of a solid.

Full-or-part-time: 8h
Theory classes: 2h
Self study : 6h

4 - Statics of rigid bodies

Description:
4.1 1st and 3rd Newton's law.
4.2 Free body diagrams.
4.3 Equations of equilibrium of a rigid body.
4.4 Mechanisms and structures in equilibrium
4.5 Relative mouvements and their intrinsec ressistance

Specific objectives:
At the end of this unit the student should be able to:

- Solve problems of statics of two-dimensional rigid bodies with coplanar force systems, either with the intervention of friction forces or not.

Full-or-part-time: 44h
Theory classes: 10h
Laboratory classes: 4h
Self study : 30h

5 - Kinematics of rigid bodies

Description:
Position and velocity analysis in a planar mechanism.

Specific objectives:
After completing this unit the student should be able to:

- Determine in a rigid body the linear speed of a point and the angular velocity of the solid from sufficient kinematic data.
- Perform the analysis of position and velocities of a planar mechanism.

Full-or-part-time: 35h
Theory classes: 12h
Laboratory classes: 1h
Self study : 22h

6 - Design and analysis of hydraulic and pneumatic systems

Description:
6.1. Pneumatics / hydraulics.
6.1.1. Concepts and basic characteristics of the two systems.
6.2 Pneumatic components.
6.2.1 Work or power elements.
6.2.2 Operating elements. Valves.
6.3 Design of basic pneumatic circuits.
6.4 Design of sequential pneumatic circuits.
6.5 Simulation of circuits.
6.6 Hydraulic equipment.
6.7 Hydraulic circuits.

Specific objectives:
At the end of this unit the student should be able to:

- Understand the main elements of a pneumatic system and hydraulic system.
- Know the operation of the oil hydraulic and pneumatic components, its symbolism and interpretation within the different applications.
- Pneumatic and hydraulic circuit design.
- Analyze the performance of pneumatic and hydraulic circuit using a simulation program.

Full-or-part-time: 26h
Theory classes: 8h
Laboratory classes: 2h
Self study : 16h

7- Equilibrium of mechanisms with the Virtual Power Theorem

Description:
Set up the equation of virtual powers in a mechanism of one degree of freedom to determine the external action that balances the mechanism.

Full-or-part-time: 15h
Theory classes: 4h
Laboratory classes: 1h
Self study : 10h

GRADING SYSTEM

The final grade of the subject is calculated with the expression:
N= AC·0.10+PR·0.24+màx[(AP1·0.20+AF·0.30),AF·0.50]+AP2·0.16 on
AC continuous evaluation, reporting activities
PR laboratory practices
AP1 partial evaluation about mechanics of rigid body
AF final evaluation about mechanics of rigid body (this qualification can substitute the AP1 qualification if superior)
AP2 pneumatic systems evaluation

There is a re-evaluation exam that you can take if you meet the requirements established by current EPSEVG regulations. The mark of the re-evaluation exam can replace/recover the % of the mark corresponding to the exams (it does not replace/recover the mark of the continuous evaluation activities (AC) nor the la boratory practices (PR)).

EXAMINATION RULES.

The conditions of realization of each test, will be specified in each particular case, in good time.

BIBLIOGRAPHY

Basic:

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- Carnicer Royo, Enrique; Mainar Hasta, Concepción. Oleohidráulica : conceptos básicos. 2a ed. Madrid: Paraninfo, 2000. ISBN 8428324387.
- Roldán Viloria, José. Neumática, hidráulica y electricidad aplicada : física aplicada. Otros fluídos. Madrid: Paraninfo, 1989, reimpr. 2009. ISBN 8428316481.
- Millán Teja, Salvador. Automatización neumática y electroneumática. Barcelona: Marcombo : Norgen, 1995. ISBN 8426710395.
- Farrando Boix, Ramón. Circuitos neumáticos, electricos e hidráulicos : curso práctico. 2a ed. Barcelona: Marcombo, 1981. ISBN 842670431X.

Complementary:

- Beer, Ferdinand Pierre ; Johnston, E. Russell ; DeWolf, John; Mazurek, David F. Mecánica de materiales [on line]. 7a ed. México: Mc-Graw-Hill Education, 2017 [Consultation: 19/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8071. ISBN 9781456260866.
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- Hyde, John; Regué, Josep; Cuspinera, Albert. Control electroneumático y electrónico. Barcelona: Norgren, Biblioteca técnica : Marcombo Boixareu, 1997. ISBN 8426710972.
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- Deppert, W; Stoll, K. Dispositivos neumáticos. Bogotá: Marcombo, 2001. ISBN 958682179X.