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340034 - SIME-F4O12 - Mechanical Systems

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

Teaching unit: 712 - EM - Department of Mechanical Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: INGRID MAGNUSSON MORER

Others: Escola Fernandez, Marc

Degree competences to which the subject contributes

Specific:

1. CE13. Knowledge of theatrical basics of machines and mechanisms

2. CE14. Knowledge and application of basics of material resistance.

Transversal:

3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Teaching methodology

The sessions are divided into classes of theory, problems and laboratory practices. Theory classes integrate the presentation of the basic theoretical concepts of thematic content of the course and applied examples are described as exercises.
In the classes of problems, the teacher presents exercises for applying the concepts studied in theory classes and proposes others for resolution by the student, individually or in groups.
In the laboratory practical classes, experimental tests are developed and is the student, individually or in groups, who must work aspects ruled by the teacher.

Learning objectives of the subject

The student will be able to:

- Define and apply the principles of machines and mechanisms.
- Define and correctly apply the principles of strength of materials.
- Analyze structures and give them dimension.
- Define and puts into practice methods of teamwork.

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Study load

Total learning time: 150h	Hours large group:	52h 30m	35.00%
	Hours medium group:	0h	0.00%
	Hours small group:	7h 30m	5.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

1 - Kinematics of mechanisms

Learning time: 15h

Theory classes: 6h
Laboratory classes: 2h
Self study : 7h

Description:
1.1 Structural analysis of mechanisms.
1.2 Joints and kinematic links
1.3 Mechanisms
1.4 Kinematic scheme

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

-Analyze the elements that are part of a mechanism and determine its degrees of freedom.
- Understand the Kinematic scheme of a mechanism

2- Equivalent systems of forces

Learning time: 12h

Theory classes: 2h
Self study : 10h

Description:
2.1 Fundamental concepts of mechanics
2.2 Vectorial operations and trigonometric laws
2.3 Moment of a force and pair of forces
2.4 Equivalent systems of forces

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

- Perform basic operations with vectors in a mechanical study of the rigid solid and correctly use the notation
- Calculate the moment of a force with respect to a point or axis in 2D and 3D
- Identify equivalent systems of forces
- Reduce a system of forces to a force-pair system
- Simplify systems of parallel forces and systems of coplanar forces

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3- Mass geometry

Learning time: 9h

Theory classes: 2h
Laboratory classes: 1h
Self study : 6h

Description:
3.1 Mass center
3.2 Moments of inertia of surfaces
3.3 Inertial properties of rigid bodies

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

- Determine the centroid of a section
- Locate the center of mass in thin plates and wires and in solids with common shapes.
- Compose different solids of known center of mass to find the center of mass of the solid resulting from the composition
- Determine the rectangular and polar moments of inertia of an area
- Determine the moment of mass inertia of a body with respect to an axis

4 - Mechanics of deformable solid

Learning time: 33h

Theory classes: 12h
Self study : 21h

Description:
3.1 Diagram of the Free Body
3.2 Equilibrium vectorial equations of the rigid solid
3.3 Structures and mechanisms in equilibrium
3.4 Relative movements and their resistances

Related activities:
At the end of this unit the student should be able to:

- Solve problems of structures and mechanisms in equilibrium
- Modeling resistance to different relative movements, according to the context

Specific objectives:
The objective of this module is to understand that the components of a mechanical system are not indeformable or indefinitely resistant to the forces they are subjected. We introduce the basic concepts of theory of elasticity and strength of materials in order to determine what stresses occur inside a body, and what deformations occur, according to external forces, the dimensions and the material the element is constructed. The purpose of this study is to size the different elements of a system to meet certain requirements of loads and deformations, or based on
an existing design, to determine the extreme conditions, ensuring that the element works within a margin of safety.

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5- Kinematics of mechanisms

Learning time: 29h

Theory classes: 8h
Self study : 21h

Description:
5.1 Kinematic variables
5.2 Study of the position of a mechanism by geometry of triangles
5.3 Simple movements of rigid bodies
5.4 Instantanious Rotation Centers
5.5 Composition of movements: velocities and accelerations (does not include movement relative to a non-inertial reference)

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

- To solve the kinematics of a mechanism, which includes the study of position, the study of velocities and the study of accelerations

6- Dynamics of mechanisms

Learning time: 19h

Theory classes: 6h
Laboratory classes: 1h
Self study : 12h

Description:
6.1 Vectorial equations for the dymanic behavior of the rigid solid: theorems of conservation of momentum and angular momentum
6.2 D'Alembert methodology
6.3 Dynamic study of mechanisms using D'Alembert methododology

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

- To perform the dynamic study of a mechanism using vectorial theorems

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7 - Mechanics of deformable bodies

Learning time: 25h

Theory classes: 8h
Laboratory classes: 2h
Self study : 15h

Description:

7.1 Introduction to the resistance and elasticity of materials
Hooke's law and the stress-deformation diagram
7.2 Simple loads
Axial strees and deformation
Shear stress
Torque stress
Bending

Specific objectives:

The objective of this module is to understand that the components of a mechanical system are not indeformable or indefinitely resistant to the forces to which they are subjected. The basic concepts of the theory of elasticity and the resistance of materials are introduced, in order to determine what stresses are produced inside a body, and what deformations are produced, depending on the external stresses, of the dimensions of the element and the material with which it is built. The purpose of this study is to be able to dimension the different elements of a system so that they meet certain requirements of loads and deformations, or, starting from an already existing design, determine to what extreme conditions we can submit it, even though the element will work within a margin of safety.

8 - Preparation and performance of written content evaluation tests

Learning time: 19h

Guided activities: 5h
Self study : 14h

Description:

8.1 Review of concepts worked on in all previous learning activities
8.2 Performing written tests of previous courses in conditions as similar as possible to those that will be on the day of the official exam
8.3 Realization of the official test

Specific objectives:

The objectives of points 8.1 and 8.2 are:
- Discern what is relevant and self-assess the level of learning achieved
- Be used to the specific conditions in which written tests are carried out

The objective of the realization of the official exam is to prove that the learning planned for the subject has been achieved through the planned activities

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Qualification system

The final grade of the subject is determined from the expression:
N= AC·0.10+PR·0.15+AMSD·0.10+max[(AP·0.20+AF·0.45),AF·0.65] where
AC are different evaluable activities that are proposed during the course
PR laboratory practices
AMSD is an evaluation of the subject of mechanical of deformable solids
AP is a partial evaluation about mechanical of rigid bodies
AF is the final evaluation about mechanical of rigid bodies (can substitute the partial AP grade if greater but not the AMSD grate)
There is a reevaluation exam that you can do when the grade of the subject is greater o equal to 3 and less than 5, and in which you reevaluate 75% corresponding to the exams (it is said, 25% portion corresponding to the continuous evaluation of practices and other activities proposed in the course is not reassessable).

Regulations for carrying out activities

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

Bibliography

Basic:

Beer, Ferdinand Pierre; Johnston, E. Russell; Mazurek, David F.; Eisenberg, Elliot R.. Mecánica vectorial para ingenieros,vol. 1, Estática. 9a ed. México [etc.]: McGraw-Hill, 2010. ISBN 9786071502773.

Beer, Ferdinand Pierre; Johnston, E. Russell; Mazurek, David F.; Eisenberg, Elliot R.. Mecánica vectorial para ingenieros, vol.2, Dinámica. 9a ed. México [etc.]: McGraw-Hill, 2010. ISBN 9786071502612.

Beer, Ferdinand Pierre; Johnston, E. Russell; DeWolf, John; Mazurek, David F. Mecánica de materiales. 5a ed. México [etc.]: Mc Graw Hill, 2010. ISBN 9786071502636.

Complementary:

Erdman, Arthur G.; Sandor, George N.; Kota, Sridhar. Mechanism design: analysis and synthesis. 4th ed. Upper Saddle River, N.J: Prentice-Hall, 2001. ISBN 0130408727.