240141 - Machine and Mechanism Theory

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering
Academic year: 2018
Degree: BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR’S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Jordi Nebot, Lluïsa
Others: Cabré Gimeno, Marc
Guzman Pérez, Ismael
Lores Garcia, Eduard
Morera Roca, Roger
Puig Ortiz, Joan
Romanos Roca, David
Sararols Figueras, Miquel
Zayas Figueras, Enrique Ernesto

Degree competences to which the subject contributes

Specific:
1. Knowledge on machines and mechanisms theory principles.
2. Knowledge and capacities to calculate, design and test machines.
General objectives
- To integrate the Theory of Machines and Mechanisms in Engineering studies using prior knowledge taught in previous subjects, working the capabilities of engineering and making it attractive and useful for students, willing or not to opt for a mechanical profile.
- To sensitize the students about the relationship between technology and society by analyzing the role of machines in this binomial and the sustainability of the current model of human activity.

Specific objectives
- Doing the kinematic, static and dynamic analysis of the mechanisms and machines, from the concepts of rigid body mechanics and using the basic and operational tools.
- Using computer applications for the calculation and the simulation of mechanisms.
- Recognizing the mechanical components and basic mechanical groups of the machines and mechanisms from examples taken of real situations.
- Doing the energy balances and calculations of performance applied to the machines.
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Total learning time: 150h</th>
<th>Hours large group: 50h</th>
<th>33.33%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<td>Hours small group: 10h</td>
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<td>6.67%</td>
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<td>Guided activities: 0h</td>
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<tr>
<td></td>
<td>Self study: 90h</td>
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<td>60.00%</td>
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# 240141 - Machine and Mechanism Theory

## Content

| **1 MACHINE AND MECHANISM** | **Learning time:** 10h 30m  
Theory classes: 4h 30m  
Laboratory classes: 0h  
Self study: 6h |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Related activities:</strong></td>
<td>Practice 1: Mechanisms of a sewing machine. Normalized representation of a mechanism.</td>
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</table>

| **2 MOBILITY** | **Learning time:** 13h 30m  
Theory classes: 5h 30m  
Laboratory classes: 2h  
Self study: 6h |
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<tbody>
<tr>
<td><strong>Related activities:</strong></td>
<td>Practice 2: Elements of machines. Analysis of various mechanisms.</td>
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</tbody>
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| **3 KINEMATICS OF MECHANISMS** | **Learning time:** 29h  
Theory classes: 10h  
Laboratory classes: 4h  
Self study: 15h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Kinematic study of mechanisms from geometric constraint equations. Redundancy and singular configurations. Kinematic study of mechanisms from kinematic constraint equations. Plane motion. Three centers theorem. Motion laws and trajectories.</td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td>Practice 3: Simulation of mechanism by computer. Analysis of a mechanism. Tutoring session 1: Explanation of course project.</td>
</tr>
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</table>
## 4 Gears and Gear Trains

### Description:

### Related activities:
Practice 4: Gearbox and differential of a car.

### Learning Time:
- Theory classes: 4h 30m
- Laboratory classes: 2h
- Self study: 9h

## 5 Dynamic Analysis

### Description:

### Related activities:
Tutoring session 2: Analysis of the normalized representation of the chosen mechanism.

### Learning Time:
- Theory classes: 4h 30m
- Laboratory classes: 2h
- Self study: 12h

## 6 Contact Force. Constraint Force. Passive Resistances

### Description:

### Learning Time:
- Theory classes: 7h
- Self study: 9h
## 7 VIRTUAL POWER METHOD

**Learning time:** 22h

- Theory classes: 7h
- Laboratory classes: 0h
- Self study: 15h

**Description:**
Virtual power associated to a system of forces. Virtual Motions. Obtaining motion equations and constraint forces. Generalized forces.

**Related activities:**
Tutoring session 3: Presentation of results of the simulation of the studied mechanism.

## 8 WORK AND POWER IN MACHINES

**Learning time:** 25h

- Theory classes: 7h
- Self study: 18h

**Description:**
Planning of activities

COURSE PROJECT

Description:
It is a project that must be presented and defended at the end of the course. For its development it must be taken into account:
· It provides a teaching load of 25 hours per student.
· The project must be done in groups of 3 students. Each of these groups will have 6 tutoring sessions of 1,5 hours throughout the semester.
· The defense, which needs the participation of all the members of the group, has a duration of 30 minutes and will take place the last days of the course in a timetable that will be define.

PARTIAL EXAM

Description:
Assessment of knowledge.

Descriptions of the assignments due and their relation to the assessment:
Solved exam.

FINAL EXAM

Description:
Assessment of knowledge.

Descriptions of the assignments due and their relation to the assessment:
Solved exam.

Qualification system

The final mark, Nfinal, rounded to the decimal point, will be the following weighted average:

\[ N_{\text{final}} = \max(0.6 \times N_{\text{ef}} + 0.3 \times N_{\text{parcial}}, 0.9 \times N_{\text{ef}}) + 0.1 \times N_{\text{exer}}, \]

where:
Nfinal: final mark
Nef: mark of the final exam. The final exam will consist on a set of exercises of similar valuation. For its performance, three hours will be given.
Nparcial: Mark of the partial exam. The partial exam will consist on a set of exercises of similar valuation. For its performance an hour and a quarter will be given.
Nexer: Mark of the mechanism simulation exercise.
Regulations for carrying out activities

During the evaluations:
- Regarding to written material, students can only dispose of an A4 original manuscript, with the contents deemed necessary.
- Calculator and basic tools for writing are essential (pencil, rubber ...) so as to help neatness in presentation.
- It is forbidden to use any storage device or information transmission, mobile phone or other.
- Questions to professors may refer only to the comprehension of the statement.

Neatness, conciseness and accuracy while doing the exercises is valued.
To obtain the highest mark possible in an exercise, the numeric values must be found and indicate their units.

Bibliography

Basic:


Complementary:


Others resources:

Collection of problems and solved examples and other material:
http://www.em.upc.edu/docencia/estudis_grau/etseib/teoria_machines