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820004 - F1FM - Physics I: Fundamentals of Mechanics

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2017
Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY 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 MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY 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)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: MURIEL BOTEY CUMELLA - GLÒRIA SALA

Others: MARTA ALARCÓN - OLGA ALCARAZ - MURIEL BOTEY - GERMINAL CAMPS - ARJUNA CASTRILLÓN - MARIA DEL BARRIO - DOMINGO GARCÍA - JORDI JOSÉ - POL LLOVERAS - JOSEP LÓPEZ - ROBERTO MACOVEZ - LUIS CARLOS PARDO - CRISTINA PERIAGO - ÀNGELS RIERA - MICHELA ROMANINI - MARIA DOLORES RUIZ - GLÒRIA SALA
Bruna Escuer, Pere
Pineda Soler, Eloy

Degree competences to which the subject contributes

Specific:
1. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.

Transversal:
2. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Teaching methodology

Teaching methodology used: exposition 30%, individual work 60%, group work 8%, guided activities 2%.

Learning objectives of the subject

Training the student through the acquisition of a working method and providing some knowledge of the principles and basic concepts of Mechanics, so that he/she can apply them to solve problems in the engineering field.

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Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Content

Subject 1: Introduction

Learning time: 11h
Theory classes: 0h
Laboratory classes: 4h
Self study : 7h

Description:
Measurement and uncertainty. Graphical analysis and linearization. Vectors.

Related activities:
Laboratory sessions:
Errors (both terms)
Simple pendulum (fall term)
Dynamic spring (spring term)

Specific objectives:
Knowing the meaning of the dimensions of a physical magnitude. Knowing the uncertainty associated with experimental measurements and knowing how to calculate the propagation of uncertainty. Learning how to draw graphical representations of experimental data and how to make linear regressions.

Subject 2: Particle kinematics

Learning time: 17h
Theory classes: 7h
Self study : 10h

Description:
Position, displacement, velocity and acceleration vectors. Motion in one dimension. Motion in two and three dimensions. Circular motion. Moving frame of reference: Galileo's transformations.

Specific objectives:
Modeling the motion for a particle, determining the equations of motion from its acceleration and initial conditions. Characterizing the linear and circular motion. Establishing the concept of frame of reference to understand the relative character of the movement.

Subject 3: Particle dynamics

Learning time: 20h
Theory classes: 8h
Self study : 12h

Description:
Forces in nature. Newton's laws of motion. Linear momentum of a particle. Impulse. Force diagrams. Static equilibrium of a particle. Non-inertial reference frames.

Specific objectives:
Understanding the concepts of force and mass and knowing Newton's laws of motion. Acquiring the ability to apply the Newton's laws to solve problems that include various particles. Knowing the differences between inertial and non-inertial frames of reference.

Subject 4: Work, energy and power	Learning time: 19h Theory classes: 6h Laboratory classes: 1h Self study : 12h

Description:
Work. Power and mechanical efficiency. Work-Kinetic energy theorem. Kinetic energy. Conservative and non conservative forces. Potential energy. Mechanical energy. Work-energy theorem. Conservation of mechanical energy. Energy diagrams in one dimension. Criteria for stable equilibrium.

Related activities:
Laboratory session:
Pulleys (fall term)

Specific objectives:
Understanding the physical concepts of work, power and energy. Identifying conservative forces and obtaining the corresponding potential energy associated with them. Problem-solving applying the work-kinetic energy theorem work and work-energy theorem. Knowing how to apply the law of conservation of mechanical energy.

Subject 5: Dynamics of systems of particles	Learning time: 20h Theory classes: 7h Laboratory classes: 1h Self study : 12h

Description:
Systems of particles. Internal and external forces in a system of particles. Center of mass. Linear momentum of a system of particles. Energy of a system of particles. Collisions and explosions.

Related activities:
Laboratory session:
Collisions (spring term)

Specific objectives:
Describing the movement of the center of masses of systems of particles. Knowing to formulate and to apply the principles of conservation of the amount of movement and of the mechanical energy of systems of particles. Applying the theorems of conservation in the study of collisions and explosions.

Subject 6: Planar rigid bodies	Learning time: 40h Theory classes: 12h Laboratory classes: 4h Self study : 24h

Description:
Torque. Equilibrium of rigid bodies. Rotation of a rigid body about a fixed axis. Moment of inertia. Angular momentum. Newton's second law for rotation. Work and power for rotation. Plane kinematics of rigid bodies. Plane dynamics of rigid bodies. Work and energy. System of rigid bodies: conservation of angular momentum.

Related activities:
Laboratory sessions:
Rotation (fall term)
Equilibrium forces (spring and fall terms)
Ballistic pendulum (spring term)

Specific objectives:
Knowing how to establish the conditions for the static equilibrium of a rigid body and solving problems of equilibrium of the rigid body. Knowing the Newton's second law for rotation and its application to solve problems. Knowing how to characterize the planar motion: coplanar translation and rotation about a fixed axis. Knowing the dynamics of the flat movement and knowing how to apply it to solve problems. Knowing and applying the angular momentum conservation in problem-solving.

Subject 7: Oscillations and waves	Learning time: 14h Theory classes: 4h Laboratory classes: 2h Self study : 8h

Description:
Characteristics of periodic motion. Simple harmonic motion. Damped harmonic oscillations. Mechanical waves. Harmonic waves. Wave equation. Energy, power and intensity of a wave. Superposition of waves: standing waves.

Related activities:
Laboratory sessions:
Standing waves on strings (spring term)
Sound waves (fall term)

Specific objectives:
Knowing the crucial role of the simple harmonic motion since for its wide application in the study of diverse physical phenomena. Identifying the condition for simple harmonic motion in terms of acceleration. Understanding the wave concepts of propagation of energy and momentum. Knowing how to describe harmonic waves. Understanding interference phenomena, in particular, standing waves.

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Qualification system

MARK M1:
- Laboratory: 20%
- Test 1: 15%
- Test 2: 25%
- Test 3: 20%
- Problems: 20%

MARK M2:
- Laboratory: 20%
- Test 3: 40%
- Problems: 40%

FINAL GRADE = maximum (M1 ; M2)

Regulations for carrying out activities

In all exams, students can use a pocket calculator. Besides, a physics formula sheet will be provided in the Problems' exam.

Bibliography

Basic:

Tipler, Paul A.; Mosca, Gene. Física per a la ciència i la tecnologia. 6ª ed. Barcelona: Reverté, 2010. ISBN 9788429144321.

Alcaraz i Sendra, Olga; López López, José; López Solanas, Vicente. Física : problemas y ejercicios resueltos. Madrid: Pearson Educación, cop. 2006. ISBN 8420544477.

Alarcón Jordán, Marta [et al.]. Física : problemes resolts. 2a ed. Barcelona: Edicions UPC, 1995-. ISBN 8483012197.

Complementary:

Gettys, W. E.; Keller, F. J.; Skove, M. J.. Física para ingeniería y ciencias. 2a ed. México, D.F.: McGraw-Hill, cop. 2005. ISBN 9789701048894.

Sears, Francis W. [et al.]. Física universitària. 12ª ed. México D. F.: Pearson Educación, 2009. ISBN 9786074422887.

Serway, Raymond A.; Jewett, John W.. Física. 3a ed.. Madrid: International Thomson, cop. 2003. ISBN 8497321685.

Others resources:

Hyperlink

Curso Interactivo de Física en Internet
http://www.sc.ehu.es/sbweb/fisica/default.htm

La baldufa: un entorn per a l'aprenentatge de la física.
http://baldufa.upc.edu/