Centre	**University College of Engineering of Vitoria-Gasteiz**
Name of subject	**25974 – Physical Foundations of Engineering**
Qualification	**Degree in Industrial Electronical and Automation Engineering**
Brief description of the subject content	**Fundamentals of mechanics, thermodynamics, fields, electromagnetism and waves**
Type	**Compulsory**
Credits	**12 ECTS**
Year	**1**
Term(s)	**1st and 2nd**
Department	**Applied Physics I**
Language	**Spanish and Basque**

Outcomes / Objectives

Description: Fundamentals of mechanics, thermodynamics, fields, electromagnetism and waves.

Learning outcomes to be achieved:

1.- Establish dimensional relations between different physical magnitudes and correctly use the International Unit System within the scope of the subject.

2.- Use the fundamental laws of physics to explain natural phenomena and the basic operation of machines and devices within the scope of the subject.

3.- Apply the fundamental laws of physics to the solution of practical problems and interpret the results within the scope of the subject.

4.- Adapt the fundamental laws of physics and their scope of validity to different technological applications within the scope of the subject.

5.- Design physical models and define their restrictions for the experimental testing of phenomena or procedures within the scope of the subject.

6.- Estimate the uncertainty in any measurement and in the results of physical calculations, and to treat experimental data to obtain quantitative cause and effect relationships within the scope of the subject.

Syllabus

1.- Introduction to Physics: The scientific method. Equations and numerical constants in physics. Nature and treatment of measurement. Unit system.

2.- Vector calculus: Algebra and vector calculus. Scalar fields and vector fields. Vector derivative. Gradient, circulation and flow.

3.- Particle kinematics: Concepts of velocity and acceleration. Intrinsic components. Galilean transformation. Relative motion.

4.- Principles of Classical Mechanics: Space and time in Classical Mechanics. Reference systems. Newton's Laws. Principle of relativity.

5.- General dynamics of particles: Equations of motion. Linear momentum, angular momentum, work and energy. Conservation theorems and principles: Conservative forces. Central forces.

6.- Oscillatory motion: Simple harmonic motion, damped and forced oscillations

7.- Particle system dynamics: Concept of material system. Discrete and continuum media. Superposition principle. Internal and external forces. Centre of mass. Internal and external motion. System dynamics. Conservation theorems and principles. Collisions.

8.- Rigid body dynamics: Rigid body model. Rigid body kinematics and dynamics. Angular momentum and kinetic energy; moment of inertia. Rolling and sliding motion. Statics.

9.- Elasticity: Real solid bodies. Introduction to mechanics of deformable solids. Hooke's Law. Energy of elastic deformation.
10.- Fluids: Fluids. Ideal liquid model. Pressure. Fluid statics and dynamics. Pascal's principle. Continuity equation. Bernoulli's theorem.
11.- Thermodynamics I: General concepts. Ideal gas model. Variables and thermodynamic equilibrium. Kinetic theory of gases. Heat, work and internal energy. First principle. Quasi-static processes with ideal gases.
12.- Thermodynamics II: Second principle. Concept of entropy. Carnot heat engine.
13.- Undulating motion: Mechanical waves. Wave equation. Harmonic waves. Examples. Superposition. Standing waves. Wave energy and intensity.
14.- Gravitational interaction: Concept of gravitational field. Historical background: Kepler's Laws. Law of Universal Gravitation. Conservation principles. Gauss's theorem.
15.- Electrostatic interaction in vacuum: Electric charge. Concept of electric field. Electric potential. Gauss's Law. Electrostatic energy. Electric dipole.
16.- Electrostatic interaction in matter: Conductors. Capacity and condensers. Electrostatic energy. Dielectrics.
17.- Stationary electric currents: Current intensity and density. Electromotive force. Ohm's, Joule's and Kirchhoff's Laws. RC circuits.
18.- Magnetostatic interaction in vacuum: Lorentz force. Biot-Savart Law. Magnetic field. Ampere's Law. Gauss's Law.
19.- Magnetostatic interaction in matter: Diamagnetic, paramagnetic and ferromagnetic materials.
20.- Electromagnetic induction: Maxwell's equations. Faraday's Law of Induction. Applications. Induction coefficients. RL circuits. Magnetic energy. Maxwell's equations.
21.- Electromagnetic waves: Propagation of electromagnetic field. EM spectrum. Polarisation of EM waves. Energy of an EM wave. Poynting vector. EM waves in material media. Doppler effect. Interference and diffraction of EM waves
22.- Introduction to geometrical optics: Fermat's principle. Snell's Law. Law of reflection. Spherical diopter. Thin lenses. Optical eye diagram. Instruments.

Methodology

Teaching Method

Face-to-Face Teaching Hours

Lectures	Seminars	Classroom practice	Lab. practice	Computer sessions	Clinical practice	Workshops	Industrial workshops	Field practice
96.0	**0.0**	**12.0**	**12.0**					

Student Hours of Non Face-To-Face Activities

Lectures	Seminars	Classroom practice	Lab. practice	Computer sessions	Clinical practice	Workshops	Industrial workshops	Field practice
144.0	**0.0**	**18.0**	18.0					

Clarification regarding the methodology

Classroom instruction will develop the subject matter content and include practical exercises.
Some classroom practice sessions (GA) will include laboratory methods, consisting of the study of the measurement theory and an introduction to the handling of experimental data.
Students are expected to study the subject matter content developed in class and solve the proposed exercises. Continuous use of tutorials is recommended. Student hours of non face-to-face activities are indicative only.

Assessment System

General criteria

1. Written essay exam
2. Practical activities (exercises, cases or problems)

Clarification regarding assessment

Continuous and individual. The final overall grade for the subject will be between 0 and 10; the pass mark is 5 points or more. The final grade is calculated as follows:

1. The five best marks achieved in the six control tests account for 25%.
2. A test on experimental laboratory methods accounts for 10%.
3. A final test on the entire content matter of the subject accounts for 65%.

A voluntary partial test will be held at the end of the first semester, which will yield a partial grade by adding the overall mark achieved in the first three control tests with a weighting of 25% plus the mark achieved in this partial test with a weighting of 75%. If the partial grade is equal to or higher than 5, students will have the option of either sitting the final exam based on the entire content of the subject matter or based only on the part taught in the second semester; if the partial grade is less than 5, students must sit the final exam based on the entire content of the subject matter, and in calculating the final overall grade for the subject the partial grade achived will not be taken into account, however the marks achieved in the first three control tests will count towards the final grade.

In order to ensure that the laboratory practice exercise and control tests are worth 35% of the final grade, students must comply with the following two requirements: (1) They must have performed all the control tests and the laboratory exercise (except for justified reasons). (2) They must have achieved a minimum mark of 3 out of 10 in the final exam. Where both requirements are not fulfilled, the final overall grade for the subject will be based on the mark achieved in the final exam only.

In the re-sit exam session students may only sit for the final exam, and the marks achieved in the control tests and laboratory exercise will be maintained, as well as the two previously established requirements.

More details and assessment criteria will be provided at the beginning of the academic year, and these will remain posted on the notice boards and on the Virtual Campus (Moodle) throughout the year.

Bibliography

Basic Bibliography

- Tipler P.A., Mosca G., (2005) Física para la ciencia y la tecnología. Ed. Reverté 5^{th} edition
- Sears F.W., Zemansky M.W., Young H.D., Freedman R.A., (1998). Física Universitaria. Ed. Addison Wesley 11^{th} edition
- Serway R.A., Jewett J.W., (2003). Física. Ed. Thomson 3^{rd} edition

In-depth Bibliography

- Eisberg R.M., Lerner L.S.,(1983). Física: fundamentos y aplicaciones. Mc Graw Hill.
- Giancoli D.C. (2009), Física para Ciencias e Ingeniería con Física Moderna. Pearson Educación.
- Feynman, Leighton y Sands. Física (The Feynman Lectures on Physics). Addison-Wesley Iberoamericana
- Other publications which will be proposed for each part of the subject matter during the course.

Websites

- http://www.sc.ehu.es/sbweb/fisica/default.htm
- http://www.colorado.edu/physics/phet/web-pages/index.html
- http://www.merlot.org/artifact/BrowseArtifacts.po?catcode=113&browsecat=100
- http://www.fisicahoy.com/