230902 - F - Physics

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018). (Teaching unit Compulsory)
ECTS credits: 6

Teaching languages: Catalan, Spanish

Coordinator: Vicente Gomis

Others: Vicente Gomis
José Eduardo García

Prior skills
Mathematical skills: vector algebra/ derivation and integration
Physical skills: fundamentals of Newtonian kinematics and dynamics

Degree competences to which the subject contributes

Basic:
CB1. (ENG) GREELEC: Que els estudiants hagin demostrat tenir i comprendre coneixements en una àrea d'estudi que neix de la base de l'educació secundària general, i que sol trobar un nivell que, si bé es recolza en llibres de text avançats, inlou també alguns aspectes que impliquin coneixements procedents de la vanguardia del seu camp d'estudi.

Specific:
CE1. (ENG) GREELEC: Capacitat per a la resolució dels problemes matemàtics que puguin plantejar-se a l'enginyeria. Aptitud per aplicar els coneixements sobre àlgebra lineal, geometria, geometria diferencial, càlcul diferencial i integral, equacions diferencial i en derivades parcials, mètodes numèrics, algorítmica numèrica, estadística i optimització. (Mòdul de formació bàsica).

General:
CG3. (ENG) GREELEC: Coneixmetn de matèries bàsiques i tecnològies que el capacitin per a l'aprenentatge de nous mètodes i tecnologies, així com que el dotin d'una gran versatilitat per adaptar-se a noves situacions.

Transversal:
CT6. (ENG) GREELEC:APRENETATGE AUTÒNOM: Detectar deficiències en el propre coneixement i superar-les mitjançant la reflexió crítica i l'elecció de la millor actuació per ampliar coneixements.

Teaching methodology
Lecturers provided by the profesor will be complemented by much more participatives solving class sesions. Specific problems will be proposed to promote autonomous and cooperative work. In parallel, the possibility of individual or small groups collective consulting sessions will be presented to the students.

Learning objectives of the subject
It must be boring to be God, and have nothing to discover. (Stephen Hawking)
Paradoxically, General physics is often presented as a rules set to be learned and correctly applied. Completely different conception is involved here where theoretical formulations are presented as tools to be used in the predictive and scientific observation and discarded if they are not useful for such purposes. Simultaneously, approaching to subjects involved in physical electronics will be performed. Initially, a classical point of view is introduced through a review of single particle physics which basics concepts will be applied in a many particle system scenario. Introduction of statistics in a many particle system problem will allow us the definition of macroscopic averaged variables thus leading us to thermodynamics. Finally, unsolved problems will be analysed introducing modern physics of great importance in electronic engineering.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 65h</th>
<th>43.33%</th>
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<tbody>
<tr>
<td>Self study: 85h</td>
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<td>56.67%</td>
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Content

SINGLE PARTICLE PHYSICS

Learning time: 62h
   Theory classes: 27h
   Self study: 35h

Description:
Review of one dimensional Newton’s laws expanding them to 2D and 3D. Correcting of misunderstood concepts. Invariants. Angular speed and kinetic moment. Work and particle energy.

Related activities:
ATENEA platform support on learning.
   • Lecturing notes
   • Resolution of proposed exercises
   • Additional information about singular subjects of special interest.

Cross-disciplinary:
   • Meetings and lectures attending possibility as docent tasks.
   • Participation in activities of other disciplines where Basic concepts on Physics are required.

Specific objectives:
A. SINGLE PARTICLE PHYSICS
1. Conservation of the particle translational momentum
   1.1. Single particle kinetics
      1.1.1. 1D Kinetics
      1.1.2 Intrinsic coordinates
      1.1.3 Changing coordinate system
   1.2. Newton’s laws and conservation of lineal momentum
2. Conservation of kinetic momentum
   2.1. Polar coordinates
   2.2. Kinetic momentum definition and properties.
   2.3. Force momentum and conservation rules
   2.4. Rotational kinetic energy: Inertia momentum
3. Energy conservation rules
   3.1. Work and kinetic energy
   3.2. Work of conservative forces: potential energy
   3.3. Mechanical energy and its conservation
   3.4. Equilibrium of conservative forces.
### PHYSICS OF A MULTIPLE PARTICLE SYSTEM

**Learning time:** 26h  
**Theory classes:** 11h  
**Self study:** 15h

**Description:**  
Application of the conservativity theorems introduced above in a many particle system by using the Centre of Mass. Discrete and continuous modelization: density definitions. Rigid solid basics.

**Specific objectives:**

**B. PHYSICS OF A MULTIPLE PARTICLE SYSTEM**  
1. Conservation theorems of linear momentum.  
   1.1. Centre of Mass (CM) definition  
   1.2. CM translational momentum and its conservation  
   1.3. CM reference system  
   1.3. Discrete and continuous mass: density and Centre of Mass  
2. Conservation theorems of kinetic momentum:  
   2.1. Kinetic momentum of the Centre of Mass  
   2.2. Inertia momentum: Steinner theorem  
   2.3. Rotational Newton’s laws: Rigid Solid  
3. Energy conservation  
   3.1. System and CM energy; Conservation theorems

### PHYSICS OF A MANY PARTICLE SYSTEM

**Learning time:** 36h  
**Theory classes:** 16h  
**Self study:** 20h

**Description:**  
Definition of macroscopic variables from microscopic modelization. Thermodynamic postulates. Heat conduction problem. What does kT mean?.

**Specific objectives:**

**C. PHYSICS OF A MANY PARTICLE SYSTEM**  
1. Root square mean speed  
2. Macroscopic V.S. microscopic: Kinetic Theory  
3. Thermodynamic state variables in a macroscopic system: Thermodynamic 0 law  
4. Thermodynamic postulates: 1st law  
5. Heat conduction  
6. Thermodynamic postulates: 2on law  
INTRODUCCIÓN INTO MODERN PHYSICS

Description:
Basic wave properties. Differences between waves and particles. Checking the ideas and contradictions of old physics: Introduction into modern physics

Specific objectives:
- D. INTRODUCCTIÓN INTO MODERN PHYSICS
  1. Particles and waves: wave fundamental characteristics
    1.1. Wave propagation
    1.2. Wave classification
    1.3. Introduction to wave equation: transverse and longitudinal waves (rope waves and sound waves)
    1.4. Energy transport: characteristic impedance
    1.5. Media interface
    1.6. Superposition: The interference
    1.7. Wave diffraction
  2. Unsolved classical physics problems
    2.1. Michelson-Morley experiment
    2.2. Black body radiation: Planck quantum hypothesis
    2.3. Photoelectric effect: the photon
    2.4. Compton effect: the photon as a single particle
  3. Quantum mechanics postulates:
    3.1. Particle-wave duality
    3.2. Stationary waves and energy quantization
    3.3. Heisenberg uncertainty principle
    3.4. Wave function: The quantum states
    3.5. Basics on energy band model

Learning time: 26h
- Theory classes: 15h
- Self study: 11h

Qualification system
On-going assessment achieved from partial tests
Global assessment form a final test
The final assessment will be determined from the final test. If the on-going assessment provides positive elements to be taken into account, the final assessment will be obtained from a combination of 40% partial tests and 60% of final test.

Bibliography
Basic: