

<b>Program</b>	<b>09TT- Engineering in Telecommunication Technologies and Services</b>
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<b>Course number and name</b>	
<b>Number</b>	95000084
<b>Name</b>	Virtual laboratory for the simulation of matter properties. Laboratorio virtual de simulación de propiedades de la materia.
<b>Semester</b>	Y2-S4

<b>Credits and contact hours</b>	
<b>ECTS Credits</b>	4.5
<b>Contact hours</b>	52

<b>Coordinator's name</b>	Perla Wahnón Benarroch
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<b>Specific course information</b>
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**Description of course content**

By using new simulation methodologies based on different computer programs and an own web site used as a Virtual Laboratory, this course is meant to help the students to gain knowledge about the micro and macroscopic properties of matter  
 This laboratory allows the students to interactively visualize the different processes and to recognize the behaviour of the quantum properties of matter.  
 Theoretical background will be taught to the students before carrying out the computational experiments.

**List of topics to be covered**

1. Free particle. Wave particle duality.
2. Potential wells and barriers. Aluminium thickness layer determination.
3. Potential well systems. Tunnelling effect.
4. Harmonic oscillator, H<sub>2</sub> vibration.
5. Hydrogen atom. Energy, radius and atomic wave functions.
6. Molecular formation, aggregates and solids.
7. Energy band diagrams of solids.
8. Obtaining energy band diagrams for different materials.
9. Lattice dynamics. 3D solid vibration.
10. Specific heat models in solids.
11. Magnetic materials properties and characteristics.
12. Properties of ferromagnetic materials.

**Prerequisites or co-requisites**

None.

**Course category in the program**

__ R (required)	X E (elective)	__ SE (selective elective)
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### Specific goals for the course

#### Specific outcomes of instruction

RA292 - Ability to explain fundamental concepts related to the properties of matter using appropriate scientific terminology.

RA294 - Ability to obtain and deduce properties and characteristics of matter by using simulation software.

RA295 - Understand the relationship between structure and electronic properties of semiconductors .

RA296 - Understand the importance of knowledge of fundamental quantum processes as knowledge base.

#### Student outcomes addressed by the course

CEB2 , CEB3, CEB4

CG3, CG7, CG8

### Bibliography and supplemental Materials

- Manual de Prácticas de Simulación de Propiedades de la Materia. Módulos I y II. P. Wahnón y col. Ed. ETSI Telecomunicación, (2000).
- Simulación de propiedades de la Materia. Fundamentos Teóricos I. P. Wahnón. Ed. ETSI Telecomunicación, (2003).
- Física Cuántica, Átomos, Moléculas, Sólidos, Núcleos y Partículas. R. Eisberg & R. Resnick. Ed: Limusa (1994).
- Introducción a la Física del Estado Sólido. Ch. Kittel. 3ª edición. Ed.: Reverté (1995)
- Simulation Software. Different software packages for development of each practice
- **Course web:** <http://www.gdc.tat.upm.es/PresentacionSPMT/SPMT-1.htm>  
<http://sfmt.gdc.tat.upm.es/>

### Teaching methodology

X lectures	X problem solving sessions	X collaborative actions	X laboratory sessions
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**Other:** SPMT platform. Own server containing the platform of the course.