Last update: 06-05-2019

230800 - FQ - Quantum 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 TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: NURIA FERRER ANGLADA

Others: Primer quadrimestre:
NURIA FERRER ANGLADA - 10
DIEGO ALEJANDRO OCHOA GUERRERO - 10

Opening hours

Timetable: Monday 10 - 13
Friday 10:30 - 13

Prior skills

Basic Physics, Mathematics and Electromagnetism, at first degree level.

Requirements

Nothing

Degree competences to which the subject contributes

Generical:

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

08 CRPE. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS. To plan and solve engineering problems in the ICT with initiative, making decisions and with creativity. To develop a method of analysis and problem solving in a systematic and creative way.

12 CPE N3. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how

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to develop a method for analysing and solving problems that is systematic, critical and creative.

Transversal:

07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

05 TEQ N3. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

Teaching methodology

Traditional courses often supported on a PC, with additional information on PPT format, that is send to the students. Exercises that represent the theory application, shown on different text groups by subject. The students will do it themselves, and then on the classroom. Sometimes with some help of the professor.
A particular work will be proposed to the students, as optional. Different subjects will be proposed by the professor, but the student could also propose their subject. It can be done individually or in a small group of two people, just exceptionally by three people.

Learning objectives of the subject

To understand the essential concepts of quantum physics and their effects on electronics and on the characterization of materials: electronic, magnetic and optical properties.
Some basic contents of the course are the following: why, when and how of quantum theory.
Understanding the microscopic and nanoscopic world. Wave-particle duality. The principles: quantization, indetermination.
Applications: energy bands in solids.
Experimental techniques of characterization: Spectroscopies.

Study load

Total learning time: 150h	Hours large group:	52h	34.67%
	Self study:	98h	65.33%

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Content

1. The origins of Quantum Theory. The photoelectric effect, Compton scattering, the diffraction of electrons.	Learning time: 2h Theory classes: 1h Guided activities: 1h

Description:
We follow a Historical path, from the grate experiments and discoveries of XX century.

2. The principles: wave-particle duality. Uncertainty.	Learning time: 6h Theory classes: 3h Guided activities: 3h

Description:
We will describe the principles, which experimental facts conducted them, and their consequences.

3. The Schrödinger equation, stationary solutions; some one-dimensional problems: square-well potentials, tunnel effect. Harmonic oscillator potential	Learning time: 12h Theory classes: 6h Laboratory classes: 6h

Description:
It is the central part of this matter: including a number of exemples, exercises and problems. Just on one dimesion.

Related activities:
They have to solve exercises and problems, proposed by the professor.

Specific objectives:
They have to be abble to solve the problems related to the Equation and its on-D applications.

4. The Schrödinger equation in three dimensions. A particle in a box: degeneration. Atoms. Angular momentum, spin.	Learning time: 10h Theory classes: 8h Laboratory classes: 2h

Description:
The concept of degeneracy appears, related to the simetry.
The necessary concepts in order to study the atom will be defined. The electronic structure of atoms, the relationship between energy quantizated levels and orbitals.

5. Molecules. Energy levels and spectra.	Learning time: 8h Theory classes: 8h

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6. Band theory of solids. Semiconductors. Superconductors.	Learning time: 4h Theory classes: 2h Laboratory classes: 2h

Description:
We will study the different solids regarding their bonding. We will study the electrical and magnetic properties.

Qualification system

- A parcial examination, plus a final examination, both 50% when the mark of the partial exam is greater than the final examination mark.
- two exercise examinations, using course notes and text books.
- An optional work, that could represent up to 20% of the final mark. It could increcase up to 2 points the final mark.

Regulations for carrying out activities

Two individual examinations of problems, where they can use books

Bibliography

Basic:

Brandt, S.; Dahmen, H.D. The picture book of quantum mechanics. 4th ed. New York [etc.]: Springer, 2012. ISBN 9781461439509.

Feynman, R.P.; Leighton, R.B.; Sands, M. Física. México: Pearson Educación, 1998. ISBN 9684443501.

French, A.P.; Taylor, E.F. Introducción a la física cuántica. Barcelona [etc.]: Reverté, 1982. ISBN 8429141677.

Lüth, H. Quantum Physics in the Nanoworld. Springer, 2013. ISBN 3642448402.

Complementary:

Eisberg, R.M. Fundamentos de física moderna. México: Limusa-Wiley, 1973. ISBN 968180418X.

Cohen-Tannoudji, C.; Diu, B.; Laloë, F. Mécanique quantique. Ed. rev., corr. et aug. Paris: Hermann, 1977. ISBN 2705657339 (V.1); 2705657673 (V.2).

Others resources:

CPET notes "Quantum Mechanics"
CPET notes, "Introducció a la Física Quàntica. problemes".