UNIVERSITÀ DI PAVIA

## Anno Accademico 2014/2015

# SEMICONDUCTOR NANOSTRUCTURES

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| **Enrollment year** | 2013/2014 |
| **Academic year** | 2014/2015 |
| **Regulations** | DM270 |
| **Academic discipline** | FIS/03 (MATERIAL PHYSICS) |
| **Department** | DEPARTMENT OF PHYSICS |
| **Course** | |
| **Curriculum** | FISICA DELLA MATERIA |
| **Year of study** | 2° |
| **Period** | 2nd semester (02/03/2015 - 12/06/2015) |
| **ECTS** | 6 |
| **Lesson hours** | 48 lesson hours |
| **Language** | ITALIAN |
| **Activity type** | ORAL TEST |
| **Teacher** | GERACE DARIO (titolare) - 4 ECTS<br>GERACE DARIO (titolare) - 2 ECTS |
| **Prerequisites** | Basic notions of quantum physics, electromagnetism, optics, solid-state physics. The course is held in the second semester, with attendance of 'Solid State Physics I' as a valuable prerequisite. |
| **Learning outcomes** | Learning of basic concepts and physical phenomena related to semiconductor nanostructures. |
| **Course contents** | The course deals with semiconductor nanostructures, i.e., low-dimensional systems giving rise to quantum confinement effects for electrons and holes in one, two or three dimensions. The following subjects will be treated: First-principles calculations, band discontinuities. Heterostructures, envelope-function method. Two-dimensional systems: quantum wells, superlattices, hetero-interfaces. Absorption and emission, interband and intersubband transitions in quantum wells, semiconductor laser. Confined excitons |

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| | and polaritons. Tunnelling and negative differential resistance, tunnelling diode, resonant tunnelling in double-barrier structures. Effects of electric and magnetic fields. Quantum Hall effect, integer and fractional. One- and zero-dimensional systems: quantum wires and quantum dots, electronic levels, transport and optical properties, correlation effects. Photonic confinement (semiconductor microcavities and photonic crystals, short mention). |
| **Teaching methods** | = |
| **Reccomended or required readings** | L.C. Andreani, Lecture notes (1998/1999).<br>P.Y. Yu, M. Cardona, Fundamentals of Semiconductors: Physics and Material Properties, 3rd edition (Springer, 2005). ).<br>J.H. Davies, The Physics of Low-dimensional Semiconductors: An Introduction (Cambridge University Press, 1998). |
| **Assessment methods** | Oral examination. For the examination it is recommended to focus on physical aspects (qualitative trends, figures, methods for measuring various physical properties) rather than on a detailed study of mathematical derivations. |
| **Further information** | Oral examination. For the examination it is recommended to focus on physical aspects (qualitative trends, figures, methods for measuring various physical properties) rather than on a detailed study of mathematical derivations. |
| **Sustainable development goals - Agenda 2030** | $lbl_legenda_sviluppo_sostenibile |