

Type of study : PhD
Module title: Quantum electronics and photonics
Module type: Elective
No ESPB: 15
Prerequisites :
<p>Module aims: Students will gain an extensive knowledge of the physics and applications of modern semiconductor quantum optoelectronic devices (quantum wells and superlattices, infra-red and terahertz lasers and photodetectors).</p>
<p>Learning outcomes: On completion of this module, student should be able to understand basic ideas and reasoning behind the development of quantum theory and its application to semiconductor quantum mechanics and quantum optoelectronics/photonics. Student should also be able to independently develop models and designs of quantum semiconductor structures, lasers and photodetectors operating in infrared and far-infrared spectral range. Student will be able to develop his/her own project idea, design the model and realise the project, deliver the presentations at international conferences and publish research results in journal papers.</p>
<p>Syllabus: Understand basic ideas and reasoning behind the semiconductor quantum mechanics. Analytical and numerical approaches to electronic structure calculation in quantum structures. Symmetrical and asymmetrical semiconductor quantum structures. Light absorption in quantum wells and super-lattices. Nonlinear optical properties. Carrier scatterings in hetero-structures. Infrared photodetectors. Semiconductor inter-subband (quantum-cascade) lasers. Electronics structure and carrier transport in quantum-cascade lasers. Physics and design of optical waveguides. Growth of heterostructure lasers by Molecular Beam Epitaxy (MBE). Infrared spectroscopy with quantum-cascade lasers. Introduction to the terahertz frequency range, and potential application areas. Terahertz quantum-cascade lasers and terahertz spectroscopy. Applications of mid infra-red and terahertz lasers.</p>
<p>Reading list:</p> <ol style="list-style-type: none"> 1. Quantum Wells, Wires and Dots, Theoretical and Computational Physics of Semiconductor Nanostructures, (3rd & 4th edition), John Wiley & Sons, Chichester 2009/2016., Paul Harrison (Ed) 2. Quantum Cascade Lasers, Oxford University Press, Oxford 2013, Jerome Faist. 3. Wave Mechanics Applied to Semiconductor Heterostructures, John Wiley & Sons, New York, 1990, Gerard Bastard 4. Semiconductor quantum microstructures, University of Belgrade, Belgrade 1997, Vitomir Milanovic and Zoran Ikonic
Contact hours: 2+1
<p>Methods of delivery: Lectures (2 hours per week), computer lab (1 hour per week),</p>