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Universität Ulm

Master of Science Physics (PO 2017)

Introduction to Quantum Electronics

Code	8812874198
ECTS credits	3
Attendance time	2
Language of instruction	English
Duration	1 Semester
Cycle	each Semester
Coordinator	Dean of Physics Studies
Instructor(s)	Dr. Siyushev
Allocation of study programmes	M. Sc. Physics, elective module, 1st or 2nd semester
Recommended prerequisites	Classical electrodynamics
Learning objectives	This course aims to introduce and provide required knowledge on quantum electronics for those who are planning to work in modern optics and utilize laser field for research and development. This course discusses interaction of coherent fields with atomic systems, specificity of the gain medium, transition rates, etc. Special place in this course is dedicated to the detailed theoretical description of laser cavities. The course is finishing by consideration of the most common laser systems and their specific characteristics.
Syllabus	• Spontaneous and stimulated transitions, Einstein coefficients, coherence of stimulated emission • Light-matter interaction, transition probability • Spectral line shape, inhomogeneous and homogeneous broadening • Absorption and amplification, gain medium, saturation • Laser oscillations, feedback, lasing threshold, resonant conditions • Gaussian beams, beam's caustics, evolution of Gaussian beams • Optical cavities, stability criterion, cavity losses

	• Lasing on several longitudinal modes, mode locking, pulsed regime, Q-switching • The most common lasers, main excitation methods, gas lasers, solid state lasers, semiconductor lasers, dye lasers, free-electron lasers
Literature	• Orazio Svelto, Principles of Lasers (Springer, 2010) • Amnon Yariv, Quantum Electronics (John Wiley and Sons 1988) • Amnon Yariv, Introduction to Optical Electronics (Holt, R.& W 1971)
Teaching and learning methods	Lecture (2 h/week)
Workload	30 hours Lecture (attendance) 60 hours Self-study and exam preparation Total: 90 hours
Assessment	The grade of the module will be the grade of the oral exam. Prerequisite for exam registration is passing the pre-course.
Grading procedure	The grade of the module will be the grade of the exam.
Basis for	Reaserch in Quantum Optics