ITMO University

Semiconductor Device Modeling

Course Workload		Assessment form (examination/ graded test/ ungraded test)
ECTS	Hours	
3	108	Exam

The course is aimed at preparing masters in the field of theoretical and technological foundations of modern lasers based on semiconductor compounds, including those with an active region based on semiconductor nanostructures. As part of the course, the student gets an idea of ээthe physical foundations of the operation of semiconductor lasers. The device characteristics of lasers, their relationship with the internal parameters of the laser structure, and ways of optimization are considered. Considerable attention is paid to issues related to the optics of semiconductor lasers. The relationship between the dimension of the active region and the characteristics of the laser, and the features due to size quantization, are considered. Some special problems of semiconductor lasers are discussed.

Course structure:

1. Physical basis of semiconductor devices

1.1. Band structure of a bulk semiconductor
1.2. Waveguide effect; Optical quantum amplifier

2. Semiconductor optics

2.1. Maxwell's equations for a dielectric non-magnetic medium
2.2. Geometric interpretation of the waveguide effect, propagation angle
2.3. Angular divergence of radiation, relation to the distribution inside the resonator

3. Semiconductor laser structures

3.1. Heterostructures, types of heterostructures
3.2. 2D quantum well, size quantization levels

4. Special Issues in Simulation of Semiconductor Devices

4.1. Powerful semiconductor lasers. Power dissipation
4.2. Direct modulation, transient, modulation response, derivation from rate equations
4.3. Noise power, signal-to-noise ratio