

ELEC-E3210 - Optoelectronics D, 20.04.2021-03.06.2021

1. Explain briefly the following terms: a) differential gain, b) Einstein coefficients, c) n index ellipsoid, d) Kerr effect, e) NEP, and f) fill factor.
2. a) Describe the different efficiencies used to characterize LEDs. b) Describe what are the most common wavelength ranges used in semiconductor LEDs and what are the semiconductor materials used in these ranges.
3. a) Explain the layer structure and the energy band structure of a double heterostructure laser. What are the two main advantages of this laser type? b) Compare the characteristics, e.g., output power, threshold current and mode structure of an edge-emitting stripe laser and a vertical-cavity surface emitting laser. c) Describe at least three diode laser component types capable of operating in a single longitudinal mode.
4. a) Explain, what processes are included in the RATE equations describing the dynamics of a semiconductor laser. Explain how each of these terms depends on the main variables. b) Describe the advantages and disadvantages of internal and external modulation schemes.
5. a) Explain the operation principles of a photoconductive, a PIN-diode and an avalanche photodiode (APD) photodetector. b) Compare the gain, noise and modulation properties of these detectors. c) Describe the physical process of impact ionization in the APD. Why should the multiplication process be as asymmetrical as possible?