# FDITE207 Fundamentals of light-matter interaction 2

**Description:**

This course explores the theoretical foundations and modern applications of quantum optics.

**Topics:**

Beginning with the historical and conceptual development of light's quantum nature, it introduces the quantization of electromagnetic fields in single-mode and multi-mode settings, photon number states, quadrature operators, and the full state space of the field. Key topics include coherent and mixed states, the density matrix formalism, the Wigner function and other quasiprobability distributions. The course covers the theory and detection of squeezed light, quantum beam splitters, and quantum coherence functions. Through the Jaynes–Cummings–Paul model, it provides a microscopic description of light–matter interaction, complemented by experimental insights from Rydberg atoms and trapped ions. The final modules address spontaneous emission, the Lamb shift, and the Casimir effect within the framework of quantum electrodynamics.

**Literature:**

Claude Cohen-Tannoudji, Jacques Dupont-Roc, and Gilbert Grynberg: *Photons and Atoms: Introduction to Quantum Electrodynamics*, Wiley-VCH, 1989, ISBN 9780471184331.