Module	***Theory of Quantum Information***
Code	71500
Instruction language	English
ECTS credits	6
Attendance time	5 hours per week
Duration	1 semester
Cycle	Each winter semester
Coordinator	Dean of Physics Studies
Instructors	Prof. Martin B Plenio
Allocation to study programmes	Physics M.Sc., elective module Wirtschaftsphysik M.Sc., elective module
Formal prerequisites	None
Recommended prerequisites	Foundations of Quantum Mechanics
Learning objectives	Students who successfully passed this module • are familiar with the theoretical concepts of Quantum Information • know the application of Quantum Information to other areas of physics, such as quantum mechanical many-particle systems, statistical physics and computer sciences.
Syllabus	• Basic concepts of Information, Correlation and Entanglement • Ensembles of quantum states and density operators • Entanglement as a resource, cloning, quantum teleportation, quantum error correction, cryptography, quantification of entanglement, majorisation theory, entanglement catalysis • Other examples of quantum resource theories, Gaussianity, Non-classicality • EPR paradox and Bell inequalities • Distance measures on quantum states, quantum fidelity, trace norm • Quantum dynamics and measurement processes • Semidefinite programming • Matrix product states for bosons and fermions, entanglement area laws, Gaussian states • Physical realizations of quantum processors
Literature	• M.A. Nielsen and I. Chuang, “Quantum Computing and Quantum Information”, Cambridge University Press • Preskill, Quantum Computation Lecture Notes
Teaching and learning methods	Lecture (3 hours per week) Exercise (2 hours per week)
Workload	45 hours lecture (attendance time) 30 hours exercise (attendance time) 105 hours self-study and exam preparation Total: 180 hours

Assessment	The module assessment consists of a graded written or oral exam. Participation in the examination requires the successful completion of problem sheets. Examination form as well as form, content and scope of the academic work will be announced at the beginning of the lecture.
Examination	12118 Theory of Quantum Information (prerequisite) 11665 Theory of Quantum Information
Grading procedure	The module grade is equal to the examination grade.
Basis for	Research in the fields of Quantum Information and Technologies