

Rapport for emne FYS4110

Stadiuminfo:	Kvalitetssikring (S2)
Sist endret:	05.03.2026 Christian Thorn (chrthorn)
Opprettet i EpN:	Nei

Generelt

Emnekodeforslag	FYS4110
Versjonskodeforslag	1
Tilknyttede campuser	UIO
Studienivå	Høyere grads nivå (500)
Administrativt sted	185.15.04.00 Fysisk institutt
Studieansvarlig sted	185.15.04.00 Fysisk institutt
Vekting	10.0
Vektingstype	Studiepoeng
Navn - bokmål	Videregående kvantemekanikk
Navn - nynorsk	
Navn - engelsk	Advanced Quantum Mechanics
Første undervisningstermin	2003 HØST
Siste undervisningstermin	
Første eksamenstermin	2003 HØST
Siste eksamenstermin	
Språk	Engelsk

Rapportering

Tilknyttede studieprogram	DRSCIENT Dr.scient.-programmet
	MNM2-FYS Fysikk
	MNUTV Innreisende utvekslingsstudenter MN
	REALMAS Realfaglige masteremner
	UVM5-LEP Lektorprogrammet
	FLYRFMAS Masteremner i realfag for flyktninger
	REALMASINT Realfaglige masteremner for internasjonale studenter
	MNM2-AST Astrofysikk
	MNM2-NUK Nukleærteknologi
	MNUTVMAS Innreisende utvekslingsstudenter masternivå MN
	REALFAG Realfag lavere grad
	MNM2-CS Computational Science

Vurdering

Antall forsøk lovlig	3
Gjelder fra termin	
Oppgave/avhandling	N
Vekt. på kar.utskrift	J
Kar. på kar.utskrift	J
Krev und.oppt første	N
Krev und.oppt alltid	N

Undervisning

Antall forsøk lovlig	
Gjelder fra termin	
Påkrevd Ja-svar	N
Beregn kval undervisningsmelding	J
Påkrevet akt.ønske	N
Ventelistenr	N
Aut. undervisningsmelding	N
Påkrevd fremmøte	N
Venteliste	J
Etteranmelding	Direktepåmelding via StudentWeb
Påmelding	Påmelding via StudentWeb - søknad
Undervisningstermin beskrivelse	Høst
Undervisningstermin	Starter høst, varer 1 semester

StudentWeb

Oppmelding	J
Privatistmelding	N
Kontroll Fkrav	J
Enkeltemneopptak i Studentweb	J
Vurd.meld språk	J
Merknad Studentweb	
Merknad Studentweb - nynorsk	
Merknad Studentweb - engelsk	

Emneinfo

Kort om emnet

Engelsk:

The course develops advanced methods in quantum mechanics, covering quantum states and measurement theory, composite systems, and open-system dynamics. It introduces phase-space methods and Gaussian states, path integrals, and geometric/topological phases, as well as field/second quantization. These tools are applied to macroscopic platforms (e.g. superconducting qubits) and key quantum-optics models.

Hva lærer du?

Engelsk:

Upon course completion the student will be able to:

- use the density-operator formalism and generalized measurement theory: compute reduced states via partial trace, evaluate expectation values, and model measurements using POVMs and Kraus/quantum-operation representations.

- analyze composite quantum systems and quantify entanglement: perform Schmidt decompositions, compute entanglement measures for simple states, and evaluate Bell/CHSH correlations and their quantum bounds.
- apply harmonic-oscillator methods and characterize nonclassical states: construct coherent and squeezed states using displacement/squeezing operators and compute quadrature uncertainties and photon-number statistics.
- employ phase-space and coherence-function methods: work with P-, Q-, and Wigner representations, compute basic quasiprobability distributions, and use first/second-order correlation functions to interpret coherence and photon statistics.
- use advanced formalisms relevant to modern quantum physics: set up coherent-state and spin path integrals, compute Berry phases for simple systems, and explain basic topological invariants (e.g., Chern number) at a conceptual/working level.
- formulate quantum field and many-body descriptions: quantize the electromagnetic field in modes, use second-quantized operators for bosons/fermions, and apply these ideas to representative model Hamiltonians.
- Model dissipation and measurement in open quantum systems: derive and solve simple Lindblad master equations, use quantum Langevin equations conceptually/operationally, and connect to noise spectra and input-output relations.
- apply the toolbox to canonical physical systems: analyze light-matter interaction (Jaynes-Cummings), spontaneous emission and photodetection, and core devices such as parametric amplifiers, lasers, and cavity/circuit QED systems (with optomechanics as an outlook).

Opptak til emnet

Engelsk:

Students admitted at UiO must apply for courses in Studentweb. Students enrolled in other Master's Degree Programmes can, on application, be admitted to the course if this is cleared by their own study programme.

Nordic citizens and applicants residing in the Nordic countries may apply to take this course as a single course student.

If you are not already enrolled as a student at UiO, please see our information about admission requirements and procedures for international applicants.

Anbefalte forkunnskaper

Engelsk:

- emne:FYS2140
- emne:FYS3110

Overlappende emner

Engelsk:

- 10 credits overlap with emne:FYS9110

Undervisning

Engelsk:

The first lecture is mandatory. If you are unable to attend, the Department of Physics has to be informed no later than the same day (studieinfo@fys.uio.no), or else you will lose your place in the course.

The course is given for a full semester with 6 hours teaching per week, with a combination of frontal lectures (4 hours) and exercise sessions (2 hours).

A group project must be completed and approved before you can sit the final exam.

See rules for mandatory activities/assignments.

Eksamen

Engelsk:

- Final oral exam which counts 100 % towards the final grade.

This course has mandatory exercises that must be approved before you can sit the final exam.

It will also be counted as one of the three attempts to sit the exam for this course, if you sit the exam for one of the following courses: emne:FYS9110

Karakterskala

Bokmål:

Emnet bruker karakterskala fra A til F, der A er beste karakter og F er stryk. Les mer om karakterskalaen

Engelsk:

Grades are awarded on a scale from A to F, where A is the best grade and F is a fail. Read more about the grading system.

Adgang til ny eller utsatt eksamen

Engelsk:

Students who can document a valid reason for absence from the regular examination are offered a postponed examination at the beginning of the next semester.

Re-scheduled examinations are not offered to students who withdraw during, or did not pass, the original examination.

Undervisningssemester

Engelsk:

If the course is offered, a minimum of four students is required for ordinary lectures to take place. If less than four students participate, an exam will be given, but one should not expect ordinary teaching.