TCM302 Quantum Mechanics IIa (2020-2023)

HUOM! OPINTOJAKSOJEN TIETOJEN TÄYTTÄMISTÄ KOORDINOIVAT KOULUTUSSUUNNITTELIJAT HANNA-MARI PEURALA JA TIINA HASARI

1. Course title

Kvanttimekaniikka IIa
Kvantmekanik IIa
Quantum Mechanics IIa

2. Course code

TCM302

Aikaisemmat leikkaavat opintojaksot 537171 Kvanttimekaniikka IIa, 5 op.

3. Course status: optional

-Which degree programme is responsible for the course?
Master's Programme in Theoretical and Computational Methods

-Which module does the course belong to?
TCM300 Theoretical and Computational Methods, Advanced Studies
PAP3002 Particle Physics and Cosmology, Advanced Studies

-Is the course available to students from other degree programmes?
Yes

4. Course level (first-, second-, third-cycle/EQF levels 6, 7 and 8)

Master's level, degree programmes in medicine, dentistry and veterinary medicine = secondcycle degree/EQF level 7
Doctoral level = third-cycle (doctoral) degree/EQF level 8

-Does the course belong to basic, intermediate or advanced studies (cf. Government Decree on University Degrees)?
Advanced studies

5. Recommended time/stage of studies for completion

-The recommended time for completion may be, e.g., after certain relevant courses have been completed.

6. Term/teaching period when the course will be offered

The course is offered in the spring term, during III period.

7. Scope of the course in credits

5 cr

8. Teacher coordinating the course

Esko Keski-Vakkuri

9. Course learning outcomes

-Description of the learning outcomes provided to students by the course
- See the competence map (https://flamma.helsinki.fi/content/res/pri/HY350274).

The student knows the formalism on non-relativistic quantum mechanics. The student can apply perturbation theory and other approximation methods to time-dependent perturbations and scattering problems in atomic, nuclear and condensed matter physics. The student understands the assumptions underlying different approximations and can estimate the range of validity of different approximation methods within the considered context. The student can couple three angular momenta, knows spherical tensor operators and can apply Wigner-Eckart theorem.

10. Course completion methods

-Will the course be offered in the form of contact teaching, or can it be taken as a distance learning course?
-Description of attendance requirements (e.g., X% attendance during the entire course or during parts of it)

-Methods of completion

Course is completed either by submitted exercise problems and additional exam problems or alternatively by a final exam.

11. Prerequisites

-Description of the courses or modules that must be completed before taking this course or what other prior learning is required

Quantum mechanics I, Electrodynamics I and II, Mathematical methods in physics IIa and IIb (or equivalent)

12. Recommended optional studies

-What other courses are recommended to be taken in addition to this course?
-Which other courses support the further development of the competence provided by this course?

13. Course content

-Description of the course content

Time dependent perturbation theory, Fermi's Golden rule, sudden and adiabatic approximations.

Scattering theory: construction of Lippmann-Schwinger equation and its solution in Born approximation.

Scattering theory: partial wave method for spherically symmetric potentials, scattering resonances.

Coupling of angular momenta, spherical tensor operators and Wingner-Eckart theorem.

Path integral formulation of quantum mechanics

14. Recommended and required literature

-What kind of literature and other materials are read during the course (reading list)?

-Which works are set reading and which are recommended as supplementary reading?

Sakurai: Advanced quantum mechanics.

15. Activities and teaching methods in support of learning

-See the competence map (https://flamma.helsinki.fi/content/res/pri/HY350274).
-Student activities
-Description of how the teacher's activities are documented

Weekly lectures, independent work of the student, solutions to exercises will be submitted weekly and graded by the teaching assistant. The exercise problems are solved working in groups in tutored exercise sessions and also independently.

16. Assessment practices and criteria, grading scale

-See the competence map (https://flamma.helsinki.fi/content/res/pri/HY350274).
-The assessment practices used are directly linked to the learning outcomes and teaching methods of the course.

The grade is determined in a way agreed in the beginning of the course.

17. Teaching language

English