The Hong Kong University of Science and Technology

UG Course Syllabus

Quantum Mechanics for Electronic Engineers

(Quantum Mechanics for Elec Eng)

ELEC 3610

Credits: 3

Pre-requisites: [MATH 2350 OR (MATH 2111 AND MATH 2351)] AND ELEC 2600 AND PHYS 1114

Exclusion: PHYS 3036, PHYS 3037

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Course Description

An introductory course on quantum mechanics for electronic engineers. This course will introduce the basic principles of quantum mechanics for electronic engineers with emphasis towards applications in semiconductor device physics and quantum information processing using electrons and photons. This course will provide the fundamental background in quantum mechanics for other senior electives in microelectronics and optoelectronics. The course delivery will be lecture-based with weekly tutorials. Students will conduct an independent study project on quantum mechanical technologies. Topics include matter waves, Schrödinger's equation, quantum wavefunctions, quantum confinement, quantum tunneling, the harmonic oscillator, the time-dependent Schrödinger equation, linear superposition and time dependence, quantum mechanical measurements, expectation values, the Hamiltonian, quantum state vectors, Hilbert space, operators, commutation relations and uncertainty relations, spin-1/2 particles and spin states, quantum interference, quantum entanglement, and quantum information processing.

Intended Learning Outcomes (ILOs)

By the end of this course, students would be able to:

1. Apply fundamental knowledge of quantum mechanics to electronic engineering.
2. Communicate effectively using concepts in quantum mechanics.
3. Understand the technological impact of quantum mechanics.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for term project presentations and term papers are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Homework	35%	26/2/2026, 5/3/2026, 19/3/2026, 2/4/2026, 23/4/2026*
Quizzes	15%	27/2/2026, 27/3/2026, 8/5/2026*
Term project presentation	5%	2/5/2026*
Term paper	10%	9/5/2026*
Final examination	35%	22/5/2026

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework	ILO1, ILO2	This task assesses students' ability to apply fundamental knowledge of quantum mechanics to solving problems relevant to electronic engineering (ILO 1), and to communicate effectively using concepts in quantum mechanics (ILO 2).
Quizzes	ILO1	This task assesses students' ability to apply fundamental knowledge of quantum mechanics to solving problems relevant to electronic engineering (ILO 1).
Term project presentation and term paper	ILO2, ILO3	The term project presentation and term paper assess students' ability to communicate effectively using concepts in quantum mechanics (ILO 2) and analyze the technological impact of quantum mechanics (ILO 3), demonstrating higher-order thinking skills of analysis and evaluation.
Final examination	ILO1	This task assesses students' ability to apply fundamental knowledge of quantum mechanics to solving problems relevant to electronic engineering (ILO 1).

Grading Rubrics

Term project presentation with ppt Max: 5	Project presentation references information and analysis that significantly supports the project work. (5)	Project presentation references information or analysis that are consistent with the project work. (4)	Project presentation is fairly clear, but with information or analysis to be supplemented. (3)	Project presentation is still understandable but lacks both supporting materials and analysis of the project topic. (2)	Project presentation is not understandable and obviously lacks understanding of the project topic or the fundamentals. (1-0)
Term project Max: 10	Term paper references information and analysis that significantly supports the project work. (10~9)	Term paper references information or analysis that are consistent with the project work. (8~7)	Term paper is fairly clear, but with information or analysis to be supplemented. (6~5)	Term paper is still understandable but lacks both supporting materials and analysis of the project topic. (4~3)	Term paper is not understandable and obviously lacks understanding of the project topic or the fundamentals. (2-0)

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of quantum mechanics for electronic engineers, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of quantum mechanics for electronic engineers, competence in problem-solving, and the ability to analyze and evaluate issues. Displays high motivation to learn and the ability to work effectively.
C	Satisfactory Performance	Possesses adequate knowledge of quantum mechanics for electronic engineers, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of quantum mechanics for electronic engineers, potential to achieve key professional skills, and the ability to make basic judgments. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of quantum mechanics for electronic engineers and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

The use of Generative AI in project is permitted with proper acknowledgement and will NOT be contributed to the students' work.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include areas for improvement. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

N/A

Required Texts and Materials

Text: Quantum Mechanics for Scientists and Engineers, David A. B. Miller, Cambridge

Reference: Quantum mechanics: theory and experiment, Mark Beck, Oxford

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources

Additional journal or magazine articles will be available on the course CANVAS page.