# PHYS 521 Quantum Mechanics (I)

# Syllabus

Objectives: To learn the fundamentals of quantum mechanics --- the basic postulates of QM, matrix and wave mechanics, spin and orbital angular momentum, time evolution, wavepacket, density opertor, symmetry.

Course Credit: 3 semester hours

Meeting Times: Tuesday and Thursday, 1:00-2:15pm

Classroom: HBH 227

Format: A lecture course with weekly problem sets, a midterm exam and a final exam.

Textbook: Modern Quantum Mechanics (2nd Edition), J.J. Sakurai and J. Napolitano, Addison-Wesley, 2011.

Course web page: https://owlspace-ccm.rice.edu/portal/site/PHYS-521-001-F14

#### Course Instructor

Han Pu

Associate Professor, Department of Physics and Astronomy

Office: BRK 309 Phone: 713-348-3570 Email: how@rice.edu

#### Homework and Grades

I plan to assign a homework set each week, usually due at the beginning of class one week later. Homework sets will be distributed in class but they will also be available from the course web page.

Homework Policy: You are encouraged to discuss the homework problems with your PHYS 521 classmates and with the instructor and the graders, but you must write up your solutions *independently*. Of course, you must not copy from anyone else's solutions.

Late Policy: The grade for late homework will be multiplied by a decaying exponential with a time constant of five days. After 5 days, the homework will not be accepted and you will receive zero point for that homework set. Late homework must be delivered to the grader or the instructor for that problem set and the student must write "Late" and the date and time on the front page.

Grading Weights: Homework: 30%

Midterm Exam: 30%

Final Exame 40%

# **Quantum Mechanics I Phys 4307 Syllabus**

Paul C.W. Davies, David S. Betts

## Quantum Mechanics I Phys 4307 Syllabus:

Library Journal ,1968-10 Science Citation Index ,1995 Vols for 1964 have guides and journal lists Introduction to Quantum Physics Stefanos Trachanas, 2017-11-17 This modern textbook offers an introduction to Quantum Mechanics as a theory that underlies the world around us from atoms and molecules to materials lasers and other applications The main features of the book are Emphasis on the key principles with minimal mathematical formalism Demystifying discussions of the basic features of quantum systems using dimensional analysis and order of magnitude estimates to develop intuition Comprehensive overview of the key concepts of quantum chemistry and the electronic structure of solids Extensive discussion of the basic processes and applications of light matter interactions Online supplement with advanced theory multiple choice guizzes etc A First Course on Symmetry, Special Relativity and Quantum Mechanics Gabor Kunstatter, Saurya Das, 2022-02-18 This book provides an in depth and accessible description of special relativity and quantum mechanics which together form the foundation of 21st century physics A novel aspect is that symmetry is given its rightful prominence as an integral part of this foundation. The book offers not only a conceptual understanding of symmetry but also the mathematical tools necessary for quantitative analysis As such it provides a valuable precursor to more focused advanced books on special relativity or quantum mechanics Students are introduced to several topics not typically covered until much later in their education These include space time diagrams the action principle a proof of Noether's theorem Lorentz vectors and tensors symmetry breaking and general relativity. The book also provides extensive descriptions on topics of current general interest such as gravitational waves cosmology Bell's theorem entanglement and quantum computing Throughout the text every opportunity is taken to emphasize the intimate connection between physics symmetry and mathematics. The style remains light despite the rigorous and intensive content. The book is intended as a stand alone or supplementary physics text for a one or two semester course for students who have completed an introductory calculus course and a first year physics course that includes Newtonian mechanics and some electrostatics Basic knowledge of linear algebra is useful but not essential as all requisite mathematical background is provided either in the body of the text or in the Appendices Interspersed through the text are well over a hundred worked examples and unsolved exercises for the Foundations of Quantum Mechanics Travis Norsen, 2017-08-17 Authored by an acclaimed teacher of quantum student physics and philosophy this textbook pays special attention to the aspects that many courses sweep under the carpet Traditional courses in quantum mechanics teach students how to use the quantum formalism to make calculations But even the best students indeed especially the best students emerge rather confused about what exactly the theory says is going on physically in microscopic systems This supplementary textbook is designed to help such students understand that they are not alone in their confusions luminaries such as Albert Einstein Erwin Schroedinger and John Stewart Bell having shared them to sharpen their understanding of the most important difficulties associated with interpreting quantum theory in a

realistic manner and to introduce them to the most promising attempts to formulate the theory in a way that is physically clear and coherent The text is accessible to students with at least one semester of prior exposure to quantum or modern physics and includes over a hundred engaging end of chapter Projects that make the book suitable for either a traditional classroom or for self study An Introduction to Quantum Physics A.P. French, 2018-05-11 Provides comprehensive coverage of all the fundamentals of quantum physics Full mathematical treatments are given Uses examples from different areas of physics to demonstrate how theories work in practice Text derived from lectures delivered at Massachusetts Quantum Mechanics, Second edition Paul C.W. Davies, David S. Betts, 2018-04-27 Quantum Institute of Technology mechanics is the key to modern physics and chemistry yet it is notoriously difficult to understand This book is designed to overcome that obstacle Clear and concise it provides an easily readable introduction intended for science undergraduates with no previous knowledge of quantum theory leading them through to the advanced topics usually encountered at the final year level Although the subject matter is standard novel techniques have been employed that considerably simplify the technical presentation The authors use their extensive experience of teaching and popularizing science to explain the many difficult abstract points of the subject in easily comprehensible language Helpful examples and thorough sets of exercises are also given to enable students to master the subject **Quantum Mechanics I** S. Rajasekar, R. Velusamy, 2022-11-28 Quantum Mechanics I The Fundamentals provides a graduate level account of the behavior of matter and energy at the molecular atomic nuclear and sub nuclear levels It covers basic concepts mathematical formalism and applications to physically important systems. This fully updated new edition addresses many topics not typically found in books at this level including Bound state solutions of quantum pendulum Morse oscillator Solutions of classical counterpart of quantum mechanical systems A criterion for bound state Scattering from a locally periodic potential and reflection less potential Modified Heisenberg relation Wave packet revival and its dynamics An asymptotic method for slowly varying potentials Klein paradox Einstein Podolsky Rosen EPR paradox and Bell's theorem Delayed choice experiments Fractional quantum mechanics Numerical methods for quantum systems A collection of problems at the end of each chapter develops students understanding of both basic concepts and the application of theory to various physically important systems This book along with the authors follow up Quantum Mechanics II Advanced Topics provides students with a broad up to date introduction to quantum mechanics Print Versions of this book also include access to the ebook version **Exploring Quantum Mechanics** Victor Galitski, Boris Karnakov, Vladimir Kogan, 2013-03-01 A series of seminal technological revolutions has led to a new generation of electronic devices miniaturized to such tiny scales where the strange laws of quantum physics come into play There is no doubt that unlike scientists and engineers of the past technology leaders of the future will have to rely on quantum mechanics in their everyday work This makes teaching and learning the subject of paramount importance for further progress Mastering quantum physics is a very non trivial task and its deep understanding can only be achieved

through working out real life problems and examples It is notoriously difficult to come up with new quantum mechanical problems that would be solvable with a pencil and paper and within a finite amount of time This book remarkably presents some 700 original problems in quantum mechanics together with detailed solutions covering nearly 1000 pages on all aspects of quantum science The material is largely new to the English speaking audience The problems have been collected over about 60 years first by the lead author the late Prof Victor Galitski Sr Over the years new problems were added and the material polished by Prof Boris Karnakov Finally Prof Victor Galitski Jr has extended the material with new problems particularly relevant to modern science Quantum Mechanics Murugan, 2014 Spread over 16 chapters this book gives a comprehensive introduction to the fundamental postulates and the mathematical formalism of quantum mechanics It spells the rules that facilitate translation of abstract mathematical information into physical terms to enable students understand the emergence of particle property in all quantum objects With the right balance of theory and problems this book gives an insight to the conceptual framework of quantum systems which shaped our understanding of the physical universe and its evolution through the years There are numerous worked out examples and practice exercises to help students gain sufficient A First Course in Quantum Mechanics Hylton Clark,1974 Quantum Mechanics Bruce Cameron Reed, 2008 Designed for the one semester course Quantum Mechanics guides students through rigorous course material providing comprehensive explanations accessible examples and intuitive equations. This text's coverage of essential topics such as harmonic oscillator barrier penetration and hydrogen atoms skillfully bridges the gap between sophomore introduction texts and lower level graduate treatments Students will find this user friendly text with numerous examples and applications sets a solid foundation for future courses in the area of Quantum Mechanics Jacket Introduction to Quantum Mechanics David I. Griffiths, 2017 This bestselling textbook teaches students how to do quantum mechanics and provides an insightful discussion Quantum Physics Mircea S. Rogalski, Stuart B. Palmer, 1999-03-01 This book presents the basic of what it actually means concepts and methods of quantum mechanics for upper level undergraduate students allowing them to master its application to real physical situations A postulate based treatment is adopted together with a gradual development of the quantum formalism of wave functions operators measurement and temporal evolution Standard topics of one dimensional and atomic motion angular momentum and approximation methods are presented in addition to detailed discussions of many particle systems atomic and nuclear radiation Appropriate mathematical tools and techniques are provided wherever necessary The core text is supplemented by 77 worked examples some of which address more complex issues and aspects of present day research The aim is to make this textbook a realistic introduction to more advanced and specialized texts The material provides full coverage of the subject matter 94 problems with solutions and a further 93 with answers only Ouantum Mechanics David Atkinson, Mahouton N. Hounkonnou, Quantum Mechanics Kenichi Konishi, Giampiero Paffuti, 2009-03-05 A modern and comprehensive textbook intended to correct the lack of such a text in times of the ever increasing importance

of the subject in contemporary science technology and everyday life With its clear pedagogical presentation and with many examples and solved problems it is useful for physics students researchers and teachers alike Quantum Physics John S. Townsend, 2009-10-07 This brilliantly innovative textbook is intended as a first introduction to quantum mechanics and its applications This brilliantly innovative textbook is intended as a first introduction to quantum mechanics and its applications Townsend's new text shuns the historical ordering that characterizes so called Modern Physics textbooks and applies a truly modern approach to this subject starting instead with contemporary single photon and single atom interference experiments The text progresses naturally from a thorough introduction to wave mechanics through applications of quantum mechanics to solid state nuclear and particle physics thereby including most of the topics normally presented in a Modern Physics course Examples of topics include blackbody radiation Bose Einstein condensation the band structure of solids and the silicon revolution the curve of binding energy and nuclear fission and fusion and the Standard Model of particle physics Students can see in quantum mechanics a common thread that ties these topics into a coherent picture of how the world works a picture that gives students confidence that quantum mechanics really works too The book also includes a chapter length appendix on special relativity for the benefit of students who have not had a previous exposure to this subject Translation into Chinese **Quantum Physics** Arno Bohm, Piotr Kielanowski, G. Bruce Mainland, 2019-11-06 This is an introductory graduate course on quantum mechanics which is presented in its general form by stressing the operator approach Representations of the algebra of the harmonic oscillator and of the algebra of angular momentum are determined in chapters 1 and 2 respectively. The algebra of angular momentum is enlarged by adding the position operator so that the algebra can be used to describe rigid and non rigid rotating molecules. The combination of quantum physical systems using direct product spaces is discussed in chapter 3 The theory is used to describe a vibrating rotator and the theoretical predictions are then compared with data for a vibrating and rotating diatomic molecule The formalism of first and second order non degenerate perturbation theory and first order degenerate perturbation theory are derived in chapter 4 Time development is described in chapter 5 using either the Schroedinger equation of motion or the Heisenberg s one An elementary mathematical tutorial forms a useful appendix for the readers who don't have prior knowledge of the general mathematical structure of quantum mechanics Path Integrals in Physics M Chaichian, A Demichev, 2018-10-03 Path Integrals in Physics Volume I Stochastic Processes and Quantum Mechanics presents the fundamentals of path integrals both the Wiener and Feynman type and their many applications in physics Accessible to a broad community of theoretical physicists the book deals with systems possessing a infinite number of degrees in freedom It discusses the general physical background and concepts of the path integral approach used followed by a detailed presentation of the most typical and important applications as well as problems with either their solutions or hints how to solve them It describes in detail various applications including systems with Grassmann variables Each chapter is self contained and can be considered as an

independent textbook The book provides a comprehensive detailed and systematic account of the subject suitable for both students and experienced researchers *Modern Physics* Luca Salasnich, Francesco Lorenzi, 2024-12-31 This textbook offers an introduction to statistical mechanics special relativity and quantum physics developed from lecture notes for the Quantum Physics course at the University of Padua Beginning with a brief review of classical statistical mechanics in the first chapter the book explores special and general relativity in the second chapter The third chapter delves into the historical analysis of light quantization while the fourth chapter discusses Niels Bohr s quantization of energy levels and electromagnetic transitions The Schr dinger equation is investigated in the fifth chapter Chapter Six covers applications of quantum mechanics including the quantum particle in a box quantum particle in harmonic potential quantum tunneling stationary perturbation theory and time dependent perturbation theory Chapter Seven outlines the basic axioms of quantum mechanics Chapter Eight focuses on quantum atomic physics emphasizing electron spin and utilizing the Dirac equation for theoretical justification The ninth chapter explains quantum mechanics principles for identical particles at zero temperature while Chapter Ten extends the discussion to quantum particles at finite temperature Chapter Eleven provides insights into quantum information and entanglement and the twelfth chapter explains the path integral approach to quantum mechanics

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