A video course on „Advanced[1] Quantum Mechanics“ 2020/21

Week 1	Lec 1	Review of Concepts in Quantum Mechanics From quantization rules to wave mechanics and beyond	H2016
W1	Lec 2	Combining System, entanglement, and the density operator	H2016 (sec. 1.2) SF2014 (ch. 6 & 7)
W2	Lec 3	Nonrelativistic Scattering Theory From the Lippmann-Schwinger equation to the 1st Born approximation	H2016 (sec. 3.1 & 3.2)
W2	Lec 4	Multiple scattering, another angle: partial wave expansion	H2016 (sec. 3.3. & 3.4)
W3	Lec 5	Path integration Basic concepts	H2016 (sec. 2.6)
W3	Lec 6	Selected examples and relation to Schrödinger's equation	FH2005
W4	Lec 7	Aharanov-Bohm effect Nonrelativistic Time-Dependent Perturbation Theory General ideas and simple examples	H2016 (sec 4.4)
W4	Lec 8	Fermi's 'golden rule' applied to the absorption coefficient	H2016 (sec 4.4)
W5	Lec 9	Quantum theory of radiation – creation and annihilation of photons	H2016 (sec. 4.5), S1967 (ch. 2)
W5	Lec 10	Quantum theory of radiation – absorption, emission and scattering of light	S1967 (ch. 2)
W6	Lec 11	Relativistic Particle Mechanics – Klein-Gordon and Dirac Equations Resume of the principles and results of special relativity	HH2020 (sec. 2.1), F1961
W6	Lec 12	Relativity and antiparticles; the electron spin	F1987, H2016 (sec. 5.3)
W7	Lec 13	Relativistic wave equations: Klein-Gordon and Pauli equations	F1961
W7	Lec 14	Relativistic wave equations: Dirac equation	F1961
W8	Lec 15	Nonrelativistic approximation to the Dirac equation	F1961
W8	Lec 16	Selected Solutions/Applications of the Dirac Equation Free particle solution, normalization and interpretation of negative energy states	F1961
W9	Lec 17	Free particles from another angle; central force problems	S1967 (sec. 3-8)
W9	Lec 18	Relativistic hydrogen-like atoms	S1967 (sec. 3-8)
W10	Lec 19	Electron self-energy and mass renormalization	S1967 (sec 2-8)
W10	Lec 20	Bethe's estimate of the Lamb shift	S1967 (sec 2-8)
W11	Lec 21	Thomson scattering revisited – the importance of negative energies	S1967 (sec. 3-9)
W11	Lec 22	Another strange infinity – the Casimir effect	H1998 (ch. 5)
W12	Lec 23	Many Particle Systems Two kinds of statistics, constructing N-particle wave functions, creation and annihilation of Fermions	H1963
W12	Lec 24	Statistical potential – the not so ideal quantum 'ideal gas'	H1963
W13	Lec 25	Electronic structure - Hartree-Fock self-consistent field method	AF1997
W13	Lec 26	Electronic structure - continuation HF; the Roothaan equations	AF1997
W14	Lec 27	Electron correlation; a glimpse of computational chemistry with GAMESS	AF1997

(Supplementary) literature:

H2016: R. Hentschke (2016) *A Course on Introductory Quantum Theory;* https://constanze.materials.uni-wuppertal.de/fileadmin/physik/theochemphysik/Skripten/QuantumTheory.pdf
SF2014: L. Susskind and A. Friedmann (2014) *Quantum Mechanics – The Theoretical Minimum.* Penguin Books
FH2005: R.P. Feynman and A.R. Hibbs (2005) *Quantum Mechanics and Path Integrals.* Dover
HH2020: R. Hentschke, Ch. Hölbling (2020) A Short Course in General Relativity and Cosmology. Springer
F1961: R.P. Feynman (2004) *Quantum Electrodynamics. Advanced Book Classics; Westview*
F1987: R.P. Feynman (1987) 'The reason for antiparticles' in *Elementary Particles and the Laws of Physics – The 1986 Dirac Memorial Lectures*. Cambridge University Press
S1967: J.J. Sakurai (1967) *Advanced Quantum Mechanics.* Addison-Wesley
H1998: K. Huang (1998) *Quantum Field Theory – From Operators to Path Integrals.* Wiley
H1963: K. Huang (1963) *Statistical Mechanics.* Wiley
AF1997: P.W. Atkins and R.S. Friedmann (1997) *Molecular Quantum Mechanics.* Oxford

[1] In the sense of a second course on QM