Lecture plan for Atomic Physics (FYSC11) spring 2019.

Literature:
SP: A. Thorne, U. Litzén and Se. Johansson, Spectrophysics.
AP: C. Foot, Atomic Physics.
QM: S. McMurry, Quantum Mechanics, GO: G. Ohlén, Phenomena of the quantum world.

Course week 1. 21 – 25 Jan (14 h + 2 h)

Historical aspects up to 1913. Bohr theory of one-electron atoms. QM: 1. SP: 1. AP: 1.1–1.4. (This is also thoroughly discussed in chapters 1 to 8 in the book by Haken and Wolf)
Quantum treatment of angular momentum. QM: 4.1 – 4.6 and 6, GO: 5, 6.
Quantum theory of one-electron atoms. QM: 7.1 – 7.2. GO: 7 (partly)
Spin. Fine structure. QM: 8.3-8.4 (Perturbation theory 11.1-11.2, GO: 6). SP: 2.1. AP: 2.
Jan 24. Problem-solving exercis.

Course week 2. 28/1 – 1/2 (8 h + 2 h)

Quantum defect and Hydrogenic (Rydberg) states. The periodic table. SP: 3.1. AP: 4.1 – 4.2.
Two-electron atoms, antisymmetric wavefunctions. QM: 13.3. SP: 2.2, 3.2. AP: 3.1 – 3.2
Many-electron atoms. The central field approximation. Configuration, term and level.
SP: 2.3. AP: 4.3, 5 – 5.2
Jan 30. Problem-solving exercis.

Course week 3. 4 – 8 Feb (8 h + 2 h)

Feb 4. Problem-solving exercis.
Monday 4/2. Deadline optional hand-in 1 kl 17.00
Many-electron atoms continued: *LS*-coupled wavefunctions, *jj*-coupling, intermediate coupling. SP: 2.3.3, 2.3.4, AP: 5.3.
Radiative transitions, Einstein coefficients, lifetimes, laser principles, selection rules and relative intensities in *LS*-multiplets. SP: 2.4, 7.5, 7.8, 7.10, 14. AP: 1.7, 5.4 and 7.1 and 7.2.
Zeeman effect and Hyperfine structure. SP: 3.8, 3.9. AP: 5.5, 6 – 6.2
Line widths and broadening effects. SP: 8, AP: 8.1, 8.2.

Course week 4. 11 – 15 Feb (2 h + 2 h + 2 h + lab)

Feb 11 Problem-solving exercis.
Feb 11. Prof. Anne L'Huillier: Laser cooling and trapping. SP: 14, AP: 9.
Feb12. Compulsory Lab preparation. The Fabry-Perot interferometer SP 13.3
Laboratory sessions: "2-electron spectra", "Diode laser spectroscopy" and "Zeeman effect"

Course week 5 and 6. 18/2 – 1/3: Laboratory sessions continued.

Course week 7. 4 – 8 March (4 h + 4 h)
March 4 and 7 Problem-solving exercises.
Molecular structure and spectra. SP: 5 and 6.1 and 6.2.

Course week 8. Monday 11/3 (2 h):
Monday 11/3: Deadline optional hand-in 2 kl 17.00
Monday 11/3: Prof. Joachim Schnadt: Atomic physics at synchrotrons

Course week 9. 18 – 22 March: (4 h +4 h + exam)
Summary lecture.
March 19. Problem-solving exercises.
Friday 22/3. Written exam. Monday 25/3 10-12 Lab visits Atomic Physics