Ultracold chemistry

Instructor: Dr. Viatcheslav Kokoouline
Time and place: Wednesday 11:00 – 12:45.
Office hours: Wednesday 14:00 – 16:00.
Email: slavako@mail.ucf.edu
Web-page: https://physics.ucf.edu/~slavako/teaching/cold_chemistry/teaching.html

The course covers fundamental topics in chemical physics at low temperatures essential to all those who will pursue research career in molecular and chemical physics. A special emphasis will be made on modern areas of research in molecular physics, such a ultra-cold molecules, processes in degenerate quantum gases (two-body and three-body collisions), in laboratory and interstellar plasma.

PREREQUISITES

Quantum Mechanics at an undergraduate level.

TEXTBOOKS

Recommended textbooks:

H. Friedrich, *Theoretical Atomic Physics*, 3th edition (Springer).

P.R. Bunker and P. Jensen *Molecular Symmetry and Spectroscopy* NRC Press (Canada); 2nd revised edition edition

C. J. Foot, *Atomic Physics*, 3th edition (Oxford University Press).

I also recommend that you have, at least, one textbook on Quantum Mechanics, for example, one of these

(1) L.D. Landau and E.M. Lifshitz *Quantum Mechanics: Non-Relativistic Theory, Volume 3.*

(2) J.J. Sakurai, Modern *Quantum Mechanics;*

(3) A.S. Davydov, *Quantum Mechanics.*

Research articles, which will be provided in class

EXAMS

There will be a final written exam. It is comprehensive and will include about 6 problems.

Exam time (preliminary time): Wednesday February 1, 2017 from 10:00 to 12:45.

DISCLAIMER

The instructor maintains the right to make any changes to the above syllabus if he finds them appropriate for the course.

Calendar:

* The schedule shown in the table below is tentative. Some adjustments from this schedule are possible.

Dates	Topic
October	Molecular Hamiltonian, Born-Oppenheimer approximation, molecular electronic states, Hartree-Fock method, diatomic interactions at large distances.
November	Introduction into scattering theory, simple reactions: elastic and inelastic scattering, scattering at low energies, threshold behavior, Landau-Zener model
December	Bound states, resonances and scattering in ultra-cold gases, two-body and three-body states near the dissociation, experiments with ultra-cold molecules, formation of ultra-cold molecules
January	Electron-molecular ion collisions in interstellar space and cold laboratory plasma, elements of quantum defect theory, review of applications.
February 1	**Final Exam: 10:00 – 12:45**