I. NMR Spectroscopy of Liquids

(1) Brief Repetition: The Basics of one- and two-dimensional NMR Spectroscopy
   - the NMR experiment and the main parts and functions of the NMR spectrometer
   - the chemical shift and proper referencing with internal and external standards
   - the J-coupling and standard correlation spectroscopy
   - processing NMR spectra
   - more special pulse sequences and tricks

(2) Multinuclear and organometallic NMR spectroscopy
   - the more common spin-1/2 nuclei, e.g. $^{19}$F, $^{31}$P, $^{29}$Si, $^{119}$Sn
   - quadrupolar nuclei, e.g. $^2$H, $^6$Li, $^{11}$B, $^{14}$N, and their characteristics and applications

(3) NMR of diamagnetic organometallic compounds
   - peculiarities of $^1$H/$^{13}$C chemical shifts
   - different J-coupling scenarios and virtual couplings
   - dynamic effects and ligand exchange

(4) Paramagnetic NMR spectroscopy
   - the basics of paramagnetic compounds and their NMR
   - tricks and examples of organometallic compounds and materials

II. NMR Spectroscopy of Solids

(1) Interactions in the solid state
   - the chemical shift anisotropy
   - the dipolar interaction
   - quadrupolar interactions

(2) Technical requirements of the solids NMR spectrometer
   - probeheads for Magic Angle Spinning (MAS)
   - high-power decoupling and cross polarization (CP)
   - equipment for special modern techniques, e.g. surface coils

III. Most Recent Applications of Liquids and Solids NMR

(1) in homogeneous and heterogeneous catalysis
   - HRMAS of suspensions (polymers, dendrimers, biomaterials, substances bound on surfaces)
   - Dipolar Dephasing, diffusion spectroscopy

(2) Inorganic and organometallic chemistry
   - solid-state NMR of materials (metal organic frameworks (MOFs), chromatography phases)
   - exchange processes and in situ reactions

(3) Applications of solid-state NMR spectroscopy in biochemistry

The students will be provided with course material (lecture and exercise material), and the powerpoint files. They should have a textbook about the basics of NMR spectroscopy, such as the book by H. Friebolin, "Basic One- and Two-dimensional NMR Spectroscopy", or "Multinuclear NMR" by J. Mason.

There will be one written midterm, and one written final exam, which both count 1/3 of the overall grade. Additionally, there are about 8 homework sets that count 1/3 for the grade. Students are also welcome to bring NMR problems from their own Ph.D. work for discussion, or give presentations themselves.

Summary: The course 618, NMR spectroscopy, will cover modern one- and two-dimensional NMR techniques for liquids, suspensions, and solids. The emphasis will be on multinuclear NMR applications on a wide range of compounds and materials that are interesting in inorganic, organometallic, and biological chemistry.