List of prerequisites

The notions listed here below are supposed to be fairly known and for the moment are not planned to be re-discussed in the MSP tutorials. Go through this list and take some time to refresh them from your previous courses. Since they range from maths to phys, you may find it very useful to do it in collaboration with fellow students whose background is different than yours. For suggestions on the standard literature on such topics, including textbooks, feel free to ask the tutors. If it emerges that major gaps are still present in the class, specific moments will be planned in the future tutorials to revisit the missing background.

- Vector spaces.
- Algebras. Quotients. Ideals.
- Topological spaces. Opens, closure, interior, ... Hausdorff topology.
- (Locally) compact topological spaces.
- Spaces: metric spaces, normed spaces, Banach spaces, Hilbert spaces.
- Topological completeness. Completion.
- Dense subsets.
- Dual of a Banach space. Bounded linear functionals.
- Operators on a Hilbert space: unbounded, bounded, compact, trace class, Hilbert-Schmidt.
- Operators on a Hilbert space: spectrum, resolvent.
- Statement of the Spectral Theorem.
- Measure spaces. Lebesgue vs Riemann integration. L^p-spaces.
- Probability space.
- Weak convergences.
- Fourier series.
- Schrödinger operators.
- Fourier transform.
- Tensor product of Hilbert spaces.
- Bosons/fermions.
- Density matrix. Reduced density matrix.
- Uncertainly principle.
- Pauli exclusion principle.
- Spin of a quantum particle.
- Laws of Thermodynamics.

- Statistical ensembles (micro-canonical, canonical, macro-canonical).
- Notion of ensemble average and time average.
- A preliminary idea of: Ergodic Theorem, notion of equilibrium, notion of Gibbs state, notion of phase transition.
- Partition function.
- One-dimensional Ising model.