This is a list of topics for the oral exam 22 and 25 Jan. 2019.

The format will be an oral examination of 25 minutes total (with strict timing in order to stay on schedule). You should prepare a 15+5 min talk with 15 min from the general topics below, and 5 min for discussion of the hand-in associated with each question. In addition, you should expect to be asked to explain various concepts from the course, define key physical quantities, and to demonstrate that you are able to set up key calculations, describe the steps needed to obtain a result, and to discuss the relevant physical consequences.

Blundell: refers to the book by Stephen Blundell: "Magnetism in Condensed Matter."
CMP2 notes: refers to the course notes found on Absalon.
JS: refers to the chapters of the book "Fundamentals of the Physics of Solids" by Jeno Solyom, also found on Absalon.

1) Magnetism I
Keywords: Magnetic moments, Bohr-van Leeuwen theorem, Hamiltonian of atoms in magnetic field, magnetism of isolated moments (paramagnetism, diamagnetism), Hund's rules, magnetic susceptibility, crystal fields.
Hand-in 1 should be included in discussion.
Relevant text: Blundell chapters 1-3.

2) Magnetism II
Keywords: Exchange mechanism, origin of Heisenberg Hamiltonian, magnetic order, frustration/helical order, spin-flop transitions, mean-field theory, different exchange mechanisms.
Hand-in 3 should be included in discussion.
Relevant text: Blundell chapters 4-5, Exercise 4.7, and CMP2 notes 14-21.

3) Magnetism III
Keywords: Spin waves, Goldstone modes, Bloch's T^3/2 law.
Hand-in 2 should be included in discussion.
Relevant text: Blundell chapters 5-6 and CMP2 notes 14-21.

4) Phase transitions
Keywords: Spontaneous symmetry breaking, Landau theory, 1. and 2. order phase transitions, correlation length, Landau theory = mean field theory, critical exponents.
Hand-in 1 should be included in discussion.
Relevant text: Blundell chapters 5-6 and CMP2 notes 1-14 and 21-25.

5) Magnetism of metals
Keywords: Pauli para-magnetism, ferromagnetism of metals, momentum-dependence of susceptibility, SDW instabilities, RKKY effect.
Hand-in 3 should be included in discussion.
Relevant text: Blundell chapter 7.

6) Superconductivity I
Keywords: London theory, Meissner effect, penetration depth, Ginzburg-Landau theory, derivation of the GL equations, coherence length.
Hand-in 1 should be included in discussion.
Relevant text: Annett Ch. 3, JS. Ch. 26.3.2, 26.4.1, CMP2 notes 40-46.

7) Superconductivity II
Keywords: Application of Ginzburg-Landau theory; type I and II superconductivity, surface energy, vortices, critical fields.
Hand-in 2 should be included in discussion.
Relevant text: CMP2 notes 45-50, JS. Ch. 26.4.1-26.4.5, lecture note.

8) Superconductivity III
Keywords: Application of Ginzburg-Landau theory; Josephson junctions, flux-quantization, SQUIDS, Little-Parks experiment.
Hand-in 2 should be included in discussion.
Relevant text: CMP2 notes 45-50, JS. Ch. 26.5, lecture not.

9) Electrons in magnetic fields
Keywords: Quantum Hall effect, edge states, Hall bar, Landau diamagnetism.
Hand-in 3 should be included in discussion.
Relevant text: JS. Ch. 22.1.1-22.1.3, 22.1.6, 22.2, 24.5.