# ELEC-E8737 Instrumentation of MRI Exam 2.11.2015

**Suorita 5 tehtävää tehtävistä 1-6! Answer 5 questions from the questions 1-6!**

1. The magnet is the main component of the MRI system. There are four main types of magnets. Give a short description of each of the four types of magnets! (5p)

2. Describe the structure of a birdcage coil! Resonance frequencies of high-pass birdcage coils can be calculated as shown in the equation below. Explain following terms in the equation: m, M and N. Explain also the significance of different m values in MRI. (5p)

$$\omega_m = \frac{1}{\sqrt{C(L + 2M \sin^2 \frac{\pi m}{N})}}$$

3. In a 3D sequence, each RF pulse excites the entire imaging volume and encoding is used for spatial discrimination. In a 1,5 T MRI unit, a set of 16x256x256 voxels is taken with a 3D imaging sequence using 10 cm FOV in frequency- and phase-encoding directions. Resolution in slice direction is 5 mm. In equipment design, the signal dynamics and range are to be specified. The required signal to noise ratio of the final image is 16. Take into consideration also the case where the spins have equal phases at the peak of the spin echo signal. Discuss the effect of imaging parameters on the resolution (number of bits) requirement of the analogue to digital converter! (5p)

4. An MRI image of a patient's torso can be taken by using a volume coil or an array of surface coils. Compare these two coil alternatives! (5p)

5. In clinical MR examination, the patient will be exposed to magnetic and electromagnetic fields. Describe what sort of biological effects MRI can have on patients and explain why! (5p)

6. Spatial localization of the MR signal requires the use of three magnetic field gradients. Describe, how temporal and spatial characteristics of the gradients affect the performance of MR imaging! (5p)

Magnetogyric ratio of $^1H$ is $267.522 \times 10^6$ rad $s^{-1}$ $T^{-1}$

Max 25 p