ELEC-E8736 Basics of MRI – Learning report

Name:

Student number:

Date:

**1. Overview of MRI Concepts** (2 p)

* Explain the principle of MRI.
* List the basic components of an MRI scanner and explain their functions.

**2. Classical Response of a Single Nucleus to a Magnetic Field** (3 p)

* Explain the relationship between the proton magnetic moment and the spin angular momentum.
* Explain why we can observe protons responding to external magnetic fields.
* Explain the precession of proton’s spin about a magnetic field. Which factors affect the precession and how?

**3. Rotating Reference Frames and Resonance** (3 p)

* Explain the use and benefit of a rotating reference frame in MRI.
* Explain the use of a radio frequency pulse in MRI.
* Explain what the effective magnetic field is.

**4. Magnetization, Relaxation, and the Bloch Equation** (3 p)

* Describe the concept of a magnetization vector. When is the magnetization at equilibrium in MRI?
* Explain the *T*1, *T*2 and *T*2-star relaxations.
* What is the Bloch equation and what can it be used for?

**7. Signal Detection** (3 p)

* Explain the detection of precessing magnetization with a coil. Start your description from the Faraday’s law.
* Explain why and how the detected MR signal is demodulated.
* Explain how the signal to noise ratio depends on the magnetic field strength B0.

**8.** **Introductory Signal Acquisition Methods: Free Induction Decay, Spin Echoes, Inversion Recovery, and Spectroscopy** (4 p)

* Explain what a free induction decay (FID) signal is and how it can be obtained.
* Explain how a spin echo can be generated.
* Explain how *T*2 can be measured.
* Explain how *T*1 can be measured
* Explain how the abundance of different molecules and nuclei in a sample can be determined in an MR experiment.

**9. One-Dimensional Fourier Imaging, *k*-Space, and Gradient Echoes** (3 p)

* Explain what frequency encoding in MRI is and how frequency encoding is done.
* Explain what a *k*-space is, how *k*-space data is collected and how *k*-space data can be transformed into an image.
* Explain how a gradient echo can be formed.

**10.** **Multi-Dimensional Fourier Imaging and Slice Excitation** (4 p)

* Explain 2 D imaging with frequency encoding in one direction and phase encoding in another direction.
* Explain how a slice can be selected. Why a rephrasing gradient is used in connection to slice selection?
* Explain how 3 D volume imaging can be performed.
* Explain what chemical shift imaging is.

**Extra feedback question** (1 p)

* Give course feedback! General comments and suggestions on such matters as course material, teaching methods, course arrangements, ways of completing the course and unnecessary overlaps with other course contents, or other matters.