

**Homework #1**  
**MRI Physics**

Due date: 2/5/2013

- (1) (10 points) In your own words, explain the difference between  $TE$  and  $TR$ .
- (2) (10 points) In your own words, explain the difference between  $T_1$ ,  $T_2$  and  $T_2^*$ .
- (3) (10 points) In your own words, explain how magnetic field gradients are used in selecting the slice of tissue to image and allowing us to image different locations of this slice.
- (4) (10 points) What is the difference between laboratory and rotating frames in our 3T scanner?
- (5) (10 points) In your own words, explain what  $k$  space, Bloch Equation and EPI are.
- (6) (10 points) In your own words, explain the difference between gradient echo and spin echo techniques.
- (7) (10 points) Calculate the Larmor frequency in a 9.4 T MRI scanner.
- (8) (30 points) I had two tissue types. Tissue 1 had a  $T_1 = 1.4$  sec and  $T_2^* = 60$  ms. Tissue 2 had  $T_1 = 700$  ms, and  $T_2^* = 30$  ms. I ran a gradient echo scan with 90 degree flip angle. Assuming they contained about the same amount of tissue water, the same magnetization and hardware scaling factors, please predict the MR signal ratio between these two tissue types if I chose
  - (a)  $TR = 3$  sec, and  $TE = 50$  ms.
  - (b)  $TR = 3$  sec, and  $TE = 6$  ms.
  - (c)  $TR = 1000$  ms, and  $TE = 6$  ms.

Please show the details of your calculation.