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EE 591 Fall 2007

MIDTERM

*This is an **90 minute, open book, open notes** exam. You may use only the Nishimura textbook, class notes, your notes, handouts, and homeworks. No other written material is allowed. **No calculators**.*

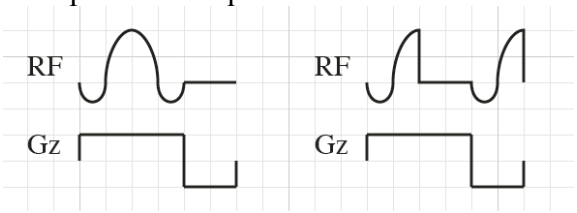
1. (15 pts) Assuming that there are no MRI system imperfections, which of the following statements apply to each magnetic field. Place an X in the boxes that apply. No explanation is required.

B0	B1	**G**	
			Influences the rate of precession about the longitudinal axis
			Time varying
			Spatially varying
			Is a safety concern due to tissue heating
			Is a safety concern due to projectiles

2. (30 pts) Are the following statements TRUE or FALSE? Provide a brief explanation.

   (a) At 1 Tesla, all NMR spins (^{1}H, ^{23}Na, etc.) precess at 42.575 MHz.

   (b) If we ignore relaxation and off-resonance, and invoke the small-tip approximation, the following two excitation pulses are equivalent:



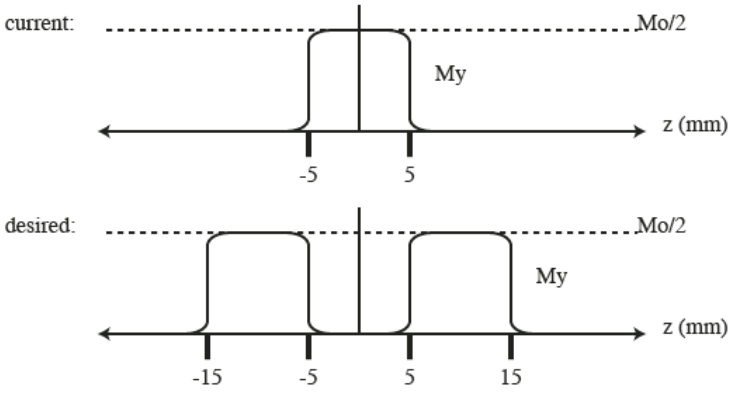
   (c) Off-resonance leads to signal loss and impulse response distortion, both of which are corrected using "spin echoes".

3. (20 pts) Solve Problem **5.7(f)** in the Nishimura textbook:

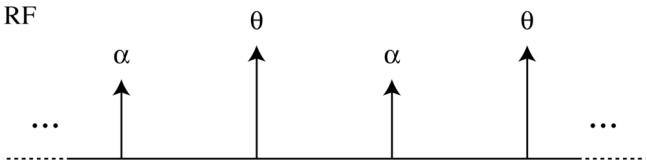
   (a) Sketch the resultant image matrix. You may clarify your answer with words if you wish.

   (b) What is the relative SNR of the new image compared to the original image?

4. (20 pts) You are given a small-tip slice selective excitation with RF waveform $B_1(t)$, constant z-gradient amplitude 1.0 G/cm, and excitation profile shown below. What RF waveform will produce the desired excitation of two slices shown below?



5. (10 pts) Consider an excitation-recovery sequence with two alternating flip angles α and θ, and repetition time TR. Assume $M_{xy} = 0$ before each RF pulse. Find S_α/S_θ in the steady state, where S_x represents the transverse signal immediately after the x excitation pulse.



6. (5 pts) A conventional 2DFT MRI magnitude image is shown below. Region A is outside the body (no signal), and region M contains heart muscle. The average magnitude in regions A and M are 10 and 100, respectively. What is the SNR of heart muscle?