

BIOMEDICAL ENGINEERING DEPARTMENT
4TH YEAR MEDICAL EQUIPMENT

MRI MIDTERM EXAM 1

February 2001

TIME ALLOWED: One Hour

SOLVE AS MUCH AS YOU CAN. SHOW YOUR WORK ON A SEPARATE PAPER.

I. Answer the following questions by selecting one answer

1. [3 points] Magnetic fields in the Tesla range are used for MRI because,
a) they are easier to generate b) they allow a stronger signal to be obtained
c) they provide better T1/T2 values d) the existing magnets happen to be in that range
e) they provide lower noise

2. [3 points] Rotating frame is preferred to lab frame because,
One) Rotating frame makes it easier to follow the motion of net magnetization
Two) It provides a nicer polar representation instead of the usual Cartesian form
Three) It makes it easier to image claustrophobic patients
Four) It makes it faster to perform imaging
Five) It reduces motion artifacts

3. [3 points] Net magnetization can be observed only when,
a) it is in the rotating frame of reference b) it is in the lab frame
c) it is in the equilibrium position d) it is in the transverse plane
e) it is in the same direction as B₀.

4. [3 points] Equilibrium position of net magnetization can be reached after an RF pulse is followed by a delay that is equal to,
a) 5 T₂ b) TR c) TE d) 5 T₂* e) 5 T₁

5. [3 points] To control the slice thickness of an RF pulse, one can do the following:
a) Change the modulation of the RF pulse b) Change the duration of the RF pulse
c) Change the bandwidth of the RF pulse d) Change the amplitude of the RF pulse
Six) Change the direction of the X and Y RF coils

6. [3 points] To increase the resolution in the frequency encoding direction for the same FOV,
a) use higher sampling rate for same duration b) use same sampling rate for longer duration
c) use higher sampling for longer duration d) apply additional phase encoding
e) use a thinner slice selection

7. [3 points] The key component for spatial encoding in MRI systems is,
a) main magnet b) quadrature coils c) gradient coils d) shim coils e) gantry

8. [3 points] Active shielding differs from passive shielding because,
One) it offers longer distance to reference fringe field lines
Two) it offers shorter distance to reference fringe field lines
Three) it has the capability to be turned on and off upon demand
Four) it offers better shielding for the patient inside the magnet
Five) it has lower image noise

9. [3 points] In conventional inversion recovery Fourier imaging, a single row in the k-space is filled within each:

- a) Scan time b) TE period c) TR period d) RF Excitation e) TI period

10. [3 points] Quenching results when,

- One) fire erupts inside the magnet
Two) Large and claustrophobic patients getting stuck inside the magnet
Three) Active shielding not working properly
Four) Superconductors becoming more resistive
Five) Improper mains voltage supply.

11. [3 points] The advantage of superconducting magnets is,

- a) high field strength b) high capital cost c) intense fringe field
d) low field homogeneity e) water cooling

12. [3 points] A T2*-weighted pulse sequence can be,

- a) A spin-echo sequence with long TR and long TE
b) A gradient echo sequence with short TR and short TE
c) A spin-echo sequence with short TR and long TE
d) A gradient sequence with long TR and long TE
e) A spin-echo sequence with long TR and short TE

13. [3 points] A slice selection gradient of 5 mT/m if combined with an RF pulse of bandwidth of 1kHz will select a slice of thickness:

- a) 1 cm b) 1 mm c) 2 mm d) 5 mm e) 8 mm

14. [3 points] To acquire 10 1-mm thick 128x256 slices with TR=3 sec and TE=70ms and , we can only use:

- a) 3-D acquisition with slab width=1cm
b) Frequency encoding in 3 different directions
c) Time of flight principle
d) Multiple overlapped thin slab acquisition
Six) multi-slice acquisition with slice thickness = 2 mm

15. [3 points] In a multi-slice TOF MRA imaging sequence, the scan parameters were: TR/TE: 300/20 msec, FOV: 20cm x 20cm, Matrix 256x256, Number of slices: 128, slice thickness: 5mm, NEX: 2, flip angle: 30 degrees. The shortest total acquisition time for this sequence is approximately:

- One) 18 minutes
Two) 245 minutes
Three) 2 minutes
Four) 9 minutes
e) Other:

16. [3 points] Image resolution can be expressed in units of,

- a) bits b) lp/mm c) 1/sec d) mm/sec e) points

17. [3 points] MRA based on TOF relies on the following phenomenon,

- One) Fresh blood contrast with stationary tissues b) Stationary blood contrast with tissues
Three) Fluid vs. solid matter contrast d) Tissue motion induced contrast
Four) Frequency shift of signal from moving blood cells

18. [3 points] Inversion time for suppressing fat ($T_1=300$ ms) in an image is approximately,

- a) 400 ms b) 800 ms c) 200 ms d) 1 sec e) other: -----

19. [3 points] In designing an RF pulse to select a 5mm slice a distance of 5 cm from the magnet isocenter in a 1.5T magnet, if the slice selection gradient is set at 5mT/m and the desired flip angle is ???, a proper design for the duration of a rectangular RF pulse can be selected approximately as:

One) 5 msec b)1 msec c) 0.5 msec d) 0.1 msec e)Other:

20. [3 points] Relaxation times are defined as,

One) time required for magnet to rest in between scans

Two) time required for coils to cool off after use

Three) time required for net magnetization to recover

Four) time required for patients to recover after MRI scan

Five) time required for k-space to be collected

II. Answer the following questions by either TRUE or FALSE:

- 21.[2 Points] People with dental implants can undergo MRI scans.
22.[2 Points] People with pace makers can undergo MRI scans.
23.[2 Points] The MRI scanning room contains the operating console and the gantry.
24.[2 Points] CRT monitors are preferred to LCD monitors for MRI.
25.[2 Points] For a small MRI clinic in the second floor in a building, open MRI is a good option.
26.[2 Points] Dynamic range describes how small image pixel size is.
27.[2 Points] The required sampling rate in the k-space is proportional to FOV.
28.[2 Points] Noise in the image depends mainly on your sampling bandwidth.
29.[2 Points] Phase encoding can be used to spatially encode any number of image/volume dimensions needed.
30.[2 Points] Frequency encoding characteristics determine the total acquisition time.
31.[2 Points] Sampling period determines the resolution in the read-out direction.
32.[2 Points] T1-weighted imaging is slower than T2-weighted imaging.
33.[2 Points] Phase encoding step that is too large results in an aliased image.
34.[2 Points] T2 contrast can only be obtained using spin echo sequences.
35.[2 Points] SNR depends on the number of phase encoding steps.

36. [10 points] Draw a properly labeled MR imaging sequence of your choice for T2* weighted imaging stating all necessary imaging parameters. Derive and draw a sketch for its k-space trajectory.

BEST OF LUCK