BIOMEDICAL ENGINEERING DEPARTMENT
4TH YEAR MEDICAL EQUIPMENT

MRI MIDTERM EXAM 2

April 2000

SOLVE AS MUCH AS YOU CAN.

1. [3 points] T1-weighted imaging is sometimes called "fat imaging" because:
a) fat appears only in this type of imaging b) fat appears the brightest tissue type
c) fat does not suffer from chemical shift d) fat appears darkest tissue type
e) fat was discovered using this technique

2. [3 points] To control the flip angle 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
e) Change the direction of the X and Y RF coils

3. [3 points] Fourier encoding means:
a) Frequency encoding b) Phase encoding c) Slice selection
d) Frequency or phase encoding e) Frequency encoding, phase encoding and slice selection

4. [3 points] Gradient moment nulling is used for:
a) Improving the slew rate of the gradient system b) Increasing the magnitude of the gradient
c) Returning the gradients to zero. d) Increase the signal to noise ratio of stationary tissues
e) Reducing motion artifacts.

5. [3 points] Shim coils are used to:
a) Improve the uniformity of the magnetic field. b) Frequency encoding gradient generation.
c) Slice selection gradient generation. d) RF pulse generation.
e) Receive the MR signal.

6. [3 points] Quadrature coils are used in MRI because:
a) They allow the reception of the quadratic components in the signal
b) They allow complex (real and imaginary) signals to be transmitted and received
c) They are easier to mount on the magnet d) They are more efficient in power consumption
e) They are less expensive

7. [3 points] The Larmor frequency at 10 cm away from the iso-center of a 1.5 Tesla magnet is:
a) 63.9 MHz b)42.6 MHz c) 28.4 MHz d) 21.3 MHz e) 85.2 MHz

8. [3 points] frequency encoding can be applied for:
a) Spatial encoding in one dimension b) Spatial encoding in two dimensions
c) Spatial encoding in three dimensions d) Shimming the magnet
e) Slice selection

9. [3 points] In conventional gradient echo, 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] The chemical shift artifact occurs when:
One) There are chemicals moving inside the field of view
Two) The SNR is low.
Three) The field of view contains species of different Larmor frequencies
Four) The tissue is oversampled in the frequency direction
Five) There is a shift in the magnetic field gradient position

11. [3 points] Discrimination of flow direction in TOF angiography can be made using:
a) Three coils in x, y and z directions
b) Spatial presaturation RF pulses
c) Receive coils in different positions
d) Patient cooperation
e) Doppler ultrasound

12. [3 points] The field of view is primarily determined by:
a) The sampling bandwidth and read-out gradient
b) SNR
c) The number of acquired k-space samples
d) The size of the reception coils
e) The image resolution.

13. [3 points] If the slice thickness is reduced by a factor of 2, the factor by which NEX must be increased to maintain the same SNR at the same resolution is:
a) 8 b) 1.41 c) 4 d) 2 e) 0.707

14. [3 points] Increasing the voxel size in the phase encoding direction at same coverage will:
a) Increase the scan time
b) Decrease the scan time
c) Have no effect on the scan time
d) Cause aliasing
e) Cause motion artifacts

15. [3 points] In Fourier imaging sequence, each TR enables the acquisition of:
a) One point in the image
b) One line in the image
c) One point in the k-space of the image
d) One line in the k-space of the image
e) A collection of random points in the image

16. [3 points] A T2-weighted pulse sequence can be:
a) A spin-echo sequence with long TR and long TE
b) A partial-flip sequence with short TR and short TE
c) A spin-echo sequence with short TR and long TE
d) A partial-flip sequence with long TR and long TE
e) A spin-echo sequence with long TR and short TE

17. [3 points] Motion artifact may result from:
a) Motion of patient during MR scan.
b) Motion of gradient coils during MR scan.
c) Lack of patient motion during exam
d) Lack of magnetic field homogeneity
e) Motion of spins inside the patient tissues.

18. [3 points] The cause of aliasing artifact is:
a) The absence of sampling in RO direction
b) The absence of sampling in PE direction
c) The under-sampling in PE direction
d) The over-sampling of the RO direction
e) The over-sampling of both the PE and RO directions

19. [3 points] Cross-talk is the result of:
a) Interference in signal lines
b) Interference between gradient coils
c) Overlapping between adjacent slice profiles
d) Overlapping of gradients
e) Overlapping of RF pulses

20. [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

21. [3 points] Periodic patient motion results in an artifact that is manifested as:
a) local blurring
b) Ghosting
c) aliasing
d) shifting
e) rotation

22. [3 points] The negative gradient lobe applied right before the RO gradient in the same direction is used to:
a) Make phase encoding
b) Make better slice selection
c) Allow longer acquisition
d) Make center of k-space in the center of acquisition window
e) Center image

23. [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
e) multi-slice acquisition with slice thickness = 2 mm

24. [3 points] Increasing number of phase encoding steps:
a) Increases SNR b) Decreases SNR c) Does not affect SNR
b) Increase SNR if FOV is kept constant
e) Decrease SNR if FOV is kept constant

25. [3 points] Increasing the bandwidth of MR data sampling:
a) Decreases SNR b) Does not affect SNR
c) Increases SNR d) Changes SNR in an unpredictable way
e) Causes SNR artifacts

26. [3 points] Acquisition time for Multi-slice scanning in MRI can be computed knowing:
a) RF pulse duration b) TE c) TR
d) TR/TE combination e) Read-out period

27. [3 points] Transverse relaxation is longer in which type of tissues?
a) water > solids > fat b) fat > solids > water c) solids > water > fat
d) water > fat > solids e) solids = water = fat

28. [10 points] Design an imaging sequence to acquire a 3-D slab of the brain of a human subject at the level of the base of the brain. The sequence must allow for maximum contrast while keeping the acquisition time minimum to allow a subsequent segmentation stage to work well. The components to be segmented are: gray matter, white matter, CSF, and fat. The image parameters should be: matrix: 256x256x128, FOV: 20 cm x 20 cm x 10 cm, NEX=1/2.

29. [10 points] It is required to select a 5 mm slice that is centered at the magnet isocenter of a 1.5 Tesla magnet and makes an angle of 45 degrees with both the y and z axes. Design RF pulse parameters that would provide a 90 degree flip for such a slice. The magnet has a max gradient strength of 25 mT/m, and RF pulse shapes include rectangular, Gaussian, Hamming, and Hanning profiles (assume whichever is most convenient for your calculations).

30. [10 points] Design a 2-D imaging sequence that enables the visualization of a small region 2cm x 2cm in size located 1cm away from the center of the magnet (center to center distance) within the brain tissue (dimensions: 20cm x 20cm) at the maximum SNR. The sequence should be T2* weighted to enable functional imaging of the brain.

31. [3 points] Draw properly labeled imaging sequences for an imaging sequence that can be used for TOF angiography. Illustrate the k-space trajectory of the sequence.

32. [10 points] In a special imaging sequence, it is required to a 3.2 cm x 3.2 cm x 3.2 cm volume symmetrically located at the magnet iso-center. Design an imaging experiment that would allow you to scan this volume with a matrix 32x32x32. Assume any missing information.

BEST OF LUCK