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BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – B.Sc.(MRIT)-2022/B.Sc.(MRIT)-2023
Course Name – Physics of Advanced Imaging Equipment-MRI
Course Code - BMRITC501
(Semester V)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Define the Larmor frequency.
a) The frequency at which protons rotate around their own axis
b) The frequency at which protons align with the external magnetic field
c) The frequency at which nuclear spins precess in a magnetic field
d) The frequency at which the magnetic field strength is applied

(ii) Illustrate the role of a radiofrequency (RF) pulse in MRI.
a) Aligns proton spins with the magnetic field
b) Excites proton spins to a higher energy state
c) Enhances proton density in tissues
d) Detects the movement of ions in the body

(iii) State the effect of T2 relaxation on signal decay in MRI.
a) No effect
b) Increases the signal strength
c) Causes rapid signal decay
d) Amplifies background noise

(iv) Identify the purpose of using gadolinium contrast agents in MRI.
a) Improve tissue relaxation times
b) Enhance signal-to-noise ratio
c) Increase signal intensity in tissues with high blood supply
d) Highlight bone structures

(v) Define TR (Repetition Time) in an MRI sequence.
a) Time between consecutive RF pulses
b) Time between the RF pulse and signal readout
c) Time it takes for protons to align with the magnetic field
d) Time taken for complete image acquisition

(vi) Illustrate how shimming is used in an MRI machine.
a) Enhances the homogeneity of the magnetic field
b) Reduces patient movement artifacts
c) Increases the strength of the gradient fields
d) Improves RF pulse accuracy

(vii) Define dynamic contrast-enhanced (DCE) MRI.

a) Imaging the metabolic composition of tissues using MR spectroscopy
b) A technique to visualize blood flow dynamics using time-series images after injecting contrast agents
c) A technique to measure the rate of water diffusion through tissues
d) A method to identify blood oxygenation in brain regions during tasks

(viii) Select the MRI technique primarily used to visualize slow-moving blood or small vessels in the brain.

a) Diffusion-weighted imaging (DWI)
b) Time-of-flight (TOF) MR angiography
c) Functional MRI (fMRI)
d) MR spectroscopy

(ix) Select the primary function of gadolinium-based contrast agents (GBCA) in MRI.

a) To enhance signal in fatty tissues
b) To shorten the T2 relaxation time
c) To increase signal intensity in T1-weighted images
d) To suppress water signal in T2-weighted images

(x) Choose the MRI safety protocol zone that is unrestricted and open to the public.

a) Zone I
b) Zone II
c) Zone III
d) Zone IV

(xi) Select the potential risk if there is a cryogen leak or quench in an MRI machine.

a) Increased image resolution
b) Release of toxic fumes
c) Sudden loss of magnetic field and helium gas asphyxiation
d) Overheating of the magnet

(xii) Identify the type of magnet that does not require a continuous power supply.

a) Superconductive
b) Resistive
c) Permanent
d) Electromagnetic

(xiii) Select the component responsible for spatial encoding in MRI.

a) RF transmitter
b) Gradient coils
c) Shim coils
d) RF receiver

(xiv) Identify the main advantage of superconductive magnets over resistive magnets.

a) Lower operational cost
b) Higher magnetic field strength
c) No cooling required
d) Easier maintenance

(xv) State the function of the computer in the MRI system.

a) Send RF pulses
b) Store and process image data
c) Maintain magnetic field strength
d) Generate gradient fields

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Explain different types of k space filling. (3)
3. Explain the difference between longitudinal and transverse magnetization in MRI. (3)
4. Explain the importance of hydrogen in MRI. (3)
5. Discuss the action of nuclear spins when a radiofrequency pulse is applied in MRI. (3)
6. Categorize the various types of fat suppression techniques used in MRI pulse sequences. (3)

OR

Differentiate between diffusion-weighted imaging (DWI) and conventional MRI sequences. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. Elaborate gradient coil used in MRI. (5)
8. Illustrate MRI magnet in details. (5)
9. Compare between GRE and STIR pulse sequence. (5)
10. Explain the significance of the Larmor frequency in MRI and how it is related to the gyromagnetic ratio and the magnetic field strength. (5)

11. Discuss the concepts of T1 and T2 relaxation times in MRI, and how they contribute to image contrast. (5)
12. Infer spin echo pulse sequence with proper diagram. (5)

OR

Describe MRI parameters. (5)

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