Name:

Enrolment No:

UPES

End Semester Examination, May 2025

Course: GE Module on MRI and Leadership & Development

Semester: 6

Program: BT-BIOMEDICAL ENGINEERING

Duration: 3 Hours

Course Code: HSBE3006

Max. Marks: 100

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	**Which of the following best explains why MRI is ideal for soft tissue imaging?** a) High-energy X-rays used b) High contrast due to water content differences c) Uses radioactive tracers d) Better imaging of bone than CT	1.5	CO1
Q 2	**Which tissue appears bright on T1-weighted images?** a) Fluid b) Fat c) Muscle d) Edema	1.5	CO2
Q 3	**In MRI, the term "slice thickness" refers to:** a) Distance between gradient coils b) Thickness of tissue imaged in one acquisition c) Depth of magnet penetration d) Width of RF coil	1.5	CO1
Q 4	**Which sequence suppresses fat signal in MRI?** a) T1-weighted b) STIR	1.5	CO3

	c) FLAIR d) GRE		
Q 5	**A major advantage of MRI over CT scan is:** a) Faster scan times b) Better bone imaging c) No ionizing radiation d) Lower cost	**1.5**	**CO3**
Q 6	**Which property of hydrogen nuclei is crucial for MRI?** a) Density b) Mass c) Spin d) Charge	**1.5**	**CO5**
Q 7	**Which parameter defines how often RF pulses are applied in an MRI sequence?** a) TE b) TR c) Flip angle d) Bandwidth	**1.5**	**CO5**
Q 8	**What does TR stand for in MRI terminology?** a) Time of Reflection b) Transverse Resonance c) Repetition Time d) Total Resistance	**1.5**	**CO2**
Q 9	**MRI signal strength is directly proportional to:** a) Size of the scanner b) Number of hydrogen nuclei c) Patient's weight d) Duration of scan	**1.5**	**CO2**
Q 10	**Which of these is most sensitive to patient movement?** a) CT scan b) MRI c) PET scan d) Ultrasound	**1.5**	**CO1**
Q 11	**Which device inside MRI scanner changes magnetic field gradients?** a) RF coil b) Magnetron c) Gradient coil d) Cryostat	**1.5**	**CO1**
Q 12	**Cryogens like liquid helium in MRI are used to:** a) Increase scan speed	**1.5**	**CO5**

	b) Cool superconducting magnets c) Improve image resolution d) Reduce radiation exposure		
Q 13	**What is the function of the RF pulse in MRI?** a) Creates images b) Aligns nuclei c) Flips magnetic spins d) Compresses tissue	**1.5**	**CO4**
Q 14	**Which part of the MRI suite must be free of all ferromagnetic materials?** a) Control room b) Magnet room (Zone IV) c) Scanner hallway d) Patient prep room	**1.5**	**CO5**
Q 15	**Which term describes how quickly nuclei return to original alignment after RF pulse?** a) T1 relaxation b) T2 dephasing c) Refraction d) Saturation	**1.5**	**CO2**
Q 16	**BOLD contrast in fMRI is based on:** a) Muscle contractions b) Blood oxygenation level differences c) Neural transmission rate d) CSF volume	**1.5**	**CO2**
Q 17	**MRI noise is primarily generated by:** a) Cooling fans b) RF coil pulses c) Gradient switching d) Patient table motors	**1.5**	**CO3**
Q 18	**Which MRI sequence is useful for detecting MS (Multiple Sclerosis)?** a) T1-weighted b) FLAIR c) STIR d) GRE	**1.5**	**CO3**
Q 19	**The main risk of gadolinium-based contrast agents is in patients with:** a) Asthma b) Liver failure	**1.5**	**CO5**

	c) Kidney dysfunction d) Heart valve disease		
Q 20	**Why is shielding essential in MRI rooms?** a) For temperature control b) To block external electromagnetic interference c) To reduce X-ray scattering d) For patient privacy	**1.5**	**CO1**
Section B **(4Qx5M=20 Marks)**			
Q 1	Describe the concept of relaxation times (T1 and T2) in MRI and their relevance in image contrast.	**5**	**CO3**
Q 2	What are the advantages and limitations of MRI compared to other imaging modalities like CT and X-ray?	**5**	**CO4**
Q 3	Explain how contrast agents like gadolinium work in MRI.*(2.5 marks)* Mention any precautions or risks involved. .*(2.5 marks)*	**5**	**CO5**
Q 4	Briefly describe the working of functional MRI (fMRI). .*(2.5 marks)* What physiological process does it measure, and how is it useful in brain studies? .*(2.5 marks)*	**5**	**CO2**
Section C **(2Qx15M=30 Marks)**			
Q 1	**Innovate a Future MRI Application:** Propose a **new or futuristic application** of MRI (e.g., portable MRI, AI-assisted diagnosis, real-time surgical guidance, etc.). Explain: • The concept and how it builds on existing MRI technology *(5 marks)* • The potential benefits for patients or doctors *(5 marks)* • Any limitations or challenges that need to be overcome *(5 marks)*	**15**	**CO2**
Q 2	**Design Your Own MRI-Friendly Environment:** Imagine you are part of a biomedical engineering team setting up a new MRI facility in a hospital. Describe the important considerations for: • The physical layout and zoning of the MRI suite. *(5 marks)* • Safety protocols for staff and patients *(3 marks)* • Types of materials used in the room *(5 marks)* • Noise control and shielding requirements *(2 marks)*	**15**	**CO4**

Section D (2Qx10M=20 Marks)			
Q 1	What are the safety precautions to be taken before entering an MRI room? *(5 Marks)* Explain why patients and staff are not allowed to carry metal objects and what steps are followed during screening. *(5 Marks)*	**10**	**CO5**
Q 2	What is the role of hydrogen atoms in MRI imaging? *(5 Marks)* Explain why hydrogen is used and how it helps in forming an image inside the body. *(5 Marks)*	**10**	**CO2**