Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 120004

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2025
Seventh Semester
Biomedical Engineering
U19BM717 – RADIOLOGICAL EQUIPMENTS
(Regulation 2019)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	State the function of the filament in an X-ray tube cathode.	2	K2	CO1
2.	Differentiate between the outcome of using high-voltage radiography (above 100 kV) versus low-voltage radiography (below 35 kV) in diagnostic imaging.	2	K2	CO1
3.	Mention any two advantages of computed radiography over film screen radiography.	2	K2	CO2
4.	How does Spiral CT improve 3D imaging compared to conventional slice-by-slice CT scanning?	2	K2	CO2
5.	Define the Larmor equation and state the relationship between the resonance frequency and the applied magnetic field strength.	2	K1	CO3
6.	In NMR, how is bulk magnetization (M) represented in a strong magnetic field (B_0) and when is it measurable?	2	K2	CO3
7.	Differentiate between SPECT and PET based on their detection principles.	2	K2	CO4
8.	Name any two quantitative non-imaging techniques used in nuclear medicine.	2	K1	CO4
9.	Differentiate between Stereotactic Radiosurgery (SRS) and Stereotactic Radiotherapy (SRT).	2	K2	CO5
10.	Mention two unique features of the CyberKnife system in radiation treatment.	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	The X-ray tube is the main component of all diagnostic X-ray machines, but its performance is limited by heat and geometric factors. Explain the working principle and major limitations of a conventional diagnostic X-ray tube, and discuss how these limitations are overcome through special design features used in two different medical applications.	13	K3	CO1
		(OR)			
	b)	Digital Subtraction Angiography (DSA) is an advanced digital fluoroscopy technique used to clearly visualize blood vessels that are not visible in conventional X-ray images. Explain the principle, operation, and image processing methods involved in DSA.	13	K3	CO1
12.	a)	Describe the main components of a CT scanner, namely the X-ray source, collimation system, detectors, and viewing system, and explain how these components work together to produce a CT image.	13	K3	CO2
		(OR)			
	b)	Explain the reconstruction principles of both analytic and iterative methods. Include their respective advantages and limitations.	13	K3	CO2
13.	a)	Describe the main hardware components of a clinical MRI system using a block diagram, and outline the role of each in producing a spatially encoded image. Include the system magnet, gradient and RF coils, and electronic and computational components involved in signal processing.	13	K2	CO3
		(OR)			
	b)	Explain the fundamental principles of Nuclear Magnetic Resonance and elaborate how T_1 and T_2 relaxation processes create image contrast in MRI. Include the interaction of nuclei with the static magnetic field, precession, Larmor frequency, RF excitation, and the differences in relaxation times among tissues.	13	K3	CO3
14.	a)	Outline the components and working of the Anger single-crystal scintillation camera, showing how it localizes gamma rays. Include the collimator, NaI(Tl) crystal, PMT array, light guide, and position-encoding system, and discuss factors that limit image quality, such as energy range and resolving time.	13	K3	CO4
		(OR)			

	b)	Compare and discuss the principles, detection systems, and technical challenges of SPECT and PET. Include photon detection, collimation methods, and photon attenuation effects.	13	K3	CO4
15.	a)	Explain how radiation protection is ensured using the main dose quantities, Absorbed Dose (Gy), Dose Equivalent, and Effective Dose (Sv). Describe the role of Quality Factors (WR) and Tissue Weighting Factors (WT) in evaluating radiation risk. Outline the design and function of Primary and Secondary Protective Barriers in medical facilities.	13	K3	CO5
		(OR)			
	b)	Discuss the working principle, planning process, and clinical advantages of 3D Conformal Radiotherapy (3DCRT). How does it improve upon conventional 2D planning?	13	K3	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	Examine the working principle and clinical relevance of functional MRI (fMRI), emphasizing the BOLD effect and how changes in oxyhemoglobin and deoxyhemoglobin cause signal variation. Analyze the Spin Echo and Gradient Echo sequences in terms of relaxation times and pulse design used for image contrast, and evaluate their differences in dominant contrast mechanisms.	15	K4	CO3
		(OR)			
	b)	Discuss the physiological basis and functional role of radiopharmaceuticals used in Bone, Renal, and Myocardial Perfusion imaging. Examine how quantitative non-imaging techniques such as dilution and clearance methods are applied to measure internal physiological parameters. Evaluate the importance of key electronic components in ensuring accuracy and reliability in nuclear counting systems.	15	K4	CO4