SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

VI SEMESTER – MDE

1910602 – MEDICAL IMAGING TECHNIQUES

Regulation – 2019

Academic Year: 2021 – 22 Even Semester

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UNIT I – RADIOGRAPHY AND FLUOROSCOPY

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment – X-Ray Tube, the collimator, Bucky Grid, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, – Fluoroscopy – X-ray Image Intensifier -Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

PART – A

Q. No	Questions	BT Level	Competence
1	Define the phenomenon of projection in radiography.	BTL1	Remembering
2	Identify the most common imaging examination and mention its limitations	BTL1	Remembering
3	List the advantages of projection radiographic systems	BTL1	Remembering
4	Explain bremsstrahlung radiation with a neat diagram	BTL3	Applying
5	What is characteristic radiation?	BTL3	Applying
6	Mention the significance of Compton scattering	BTL3	Applying
7	Tabulate the frequency range, wavelength, photon energies for soft, diagnostic x-rays and visible light	BTL1	Remembering
8	Define mathematically the EM radiation with energy equations	BTL1	Remembering
9	Enumerate the properties of x-rays	BTL1	Remembering
10	Point out the significance of units of X-rays	BTL4	Analyzing
11	Point out the importance of collimators	BTL4	Analyzing
12	Assess the importance of Bucky grids	BTL5	Evaluating
13	Summarize the various features of Compensation filters	BTL5	Evaluating
14	Draw the schematic diagram of x-ray tube	BTL6	Creating
15	Sketch the schematic diagram for different beam restrictors	BTL6	Creating
16	Classify graphically the two different contrast agents	BTL4	Analyzing
17	Describe the constructional details of intensifying screens	BTL2	Understanding
18	Discuss the constructional details of x-ray image intensifiers (XRII)	BTL2	Understanding
19	Estimate the spatial resolution of a mammogram when the pixel size is 10μm in (line pairs per mm)	BTL2	Understanding
20	Describe the formation of latent image and the technique used to convert this image into digital form	BTL2	Understanding

	PART – B		
1	(i) Explain the production of x-rays with detail description of construction of x-ray tubes (9) (ii) Contrast the x-ray spectra leaving the tube filter and body with a neat graph (4)	BTL2	Understanding
2	Assess various different beam restrictors used in X-rays with neat diagrams (13)	BTL5	Evaluating
3	Discuss the various aspects of compensation filters and its types with a neat diagram (13)	BTL2	Understanding
4	Examine the significance of the contrasting agents and plot the attenuation coefficients for different contrasting agents (13)	BTL1	Remembering
5	Classify different types of Grids with a neat labelled diagrams for a typical x-ray system (13)	BTL4	Analyzing
6	Illustrate the following with a neat diagrams (i) Intensifying screens (5) (ii) Radiographic cassettes (4) (iii) Radiographic films (4)	BTL3	Applying
7	Draw and explain the working of x-ray image intensifiers with a schematic diagram (13)	BTL3	Applying
8	Generalize the working of mammography system by formulating the importance of spatial resolution numerically to determine the breast cancer (13)	BTL6	Creating
9	(i) Analzye the working of Digital fluoroscopy system by pointing out the importance of image formation. (6) (ii) Also tabulate the general procedure in fluoroscopy and its application (7)	BTL4	Analyzing
10	Explain in detail the interaction of radiation with matter and derive the relation between absorbance and concentration with a neat diagram (13)	BTL1	Remembering
11	Describe in detail the construction and working of stationary anode x-ray tube (13)	BTL1	Remembering
12	Describe in detail the significance of Airgaps, and Scanning Slits	BTL2	Understanding
13	Describe various steps involved to develop digital image from the latent form with a neat diagram of computed radiography cassette (13)	BTL1	Remembering
14	Analyze the various filtration methods used in x-rays (13)	BTL3	Analyzing
	PART – C		
1	Evaluate the working of digital subtraction angiography system with a neat block diagram.	BTL5	Evaluating
2	Evaluate the automatic dose control system used in the x-ray image intensifiers with a neat block diagram	BTL5	Evaluating
3	Draw the schematic representation for developing a system for automatic exposure control	BTL6	Creating
4	Sketch the exposure timing systems using RC timing circuits	BTL6	Creating

UNIT II – COMPUTED TOMOGRAPHY			
Principles of sectional imaging, Principles of computed Tomographic Imaging - Scan motions, X-ray sources. Influences of Images quality: Unsharpness- contrast - Image Noise-2-D image reconstruction techniques-Back projection and iterative.			
PART – A			
Q. No	**Questions**	**BT Level**	**Competence**
1	Define 2-D Transform	BTL1	Remembering
2	Identify why conventional radiograph is not a tomogram	BTL1	Remembering
3	Describe a tomogram obtained in CT	BTL1	Remembering
4	Draw the geometry of the 2 G CT machine.	BTL3	Applying
5	Sketch the geometry of the 3 G CT machine.	BTL3	Applying
6	Illustrate the geometry of the 4 G CT machine	BTL3	Applying
7	Define the axial cross section of an image	BTL1	Remembering
8	Mention the significance of CT number	BTL1	Remembering
9	Enumerate the advantages of 1 G CT machines	BTL1	Remembering
10	Point out the design importance of the 5 G CT machine	BTL4	Analyzing
11	Illustrate the back projection image and back projection summation image	BTL4	Analyzing
12	Assess the iterative reconstruction technique	BTL5	Evaluating
13	Summarize the problems of image quality in CT	BTL5	Evaluating
14	Draw the gantry geometry in CT	BTL6	Creating
15	Tabulate the schematic of three detectors used in CT	BTL6	Creating
16	Classify the types of reconstruction techniques used in CT	BTL4	Analyzing
17	Describe the significance of slip rings	BTL2	Understanding
18	Discuss the constructional details of x-ray image intensifiers (XRII)	BTL2	Understanding
19	List different artefacts affecting the image quality in CT	BTL2	Understanding
20	Describe the importance of patient dose in CT machines	BTL2	Understanding
PART-B			
1	(i) Explain the construction and working principle of Xray source in CT machines (7) (ii) Explain the construction and working principle of collimators in CT machines (6)	BTL2	Understanding
2	Assess different features of Dual energy Computed Tomography. (13)	BTL5	Evaluating
3	Discuss the various aspects CT processing systems (13)	BTL2	Understanding
4	Examine the significance of a viewing system for CT with a neat block diagram (13)	BTL1	Remembering
5	Classify and tabulate various features of CT systems across different generations (13)	BTL4	Analyzing

6	Illustrate the following with a neat diagrams (i) Gantry (5) (ii) Slip rings (4) (iii) Patient table (4)	BTL3	Applying
7	Draw and explain the working principle of CT machine with a schematic diagram (13)	BTL3	Applying
8	Generalize the various procedures involved iterative reconstruction techniques used in CT (13)	BTL6	Creating
9	(i) Analzye the various steps involved back projection algorithm used in CT (13)	BTL4	Analyzing
10	Explain in detail the various types of noises in a CT Image (13)	BTL1	Remembering
11	Explain in detail the various types of artefacts prone to occur in a CT machine (13)	BTL1	Remembering
12	Describe in detail the significance of Contrast scale and window width (13)	BTL2	Understanding
13	Describe various types of CT detectors used in a CT machine with a neat schematic representation (13)	BTL1	Remembering
14	Analyze the various components of a ultrafast electron beam CT scanner with neat schematic diagram (13)	BTL3	Analyzing
	PART - C		
1	Evaluate the CT instrumentation for the first, second, third and fourth generation CT machines (15)	BTL 5	Evaluating
2	Formulate and prepare various reconstruction methods used in CT machines (15)	BTL6	Creating
3	Assess the significance of the following (i) Storing documentation (5) (ii) Gantry geometry (5) (iii) Patient dosage (5)	BTL 5	Evaluating
4	Describe the following components in a CT machine (i) Slip rings (5) (ii) X-ray source (5) (iii) CT detectors (5)	BTL 6	Creating

UNIT III - MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY

Fundamentals of magnetic resonance- overview - Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, contrast agents- tissue contrast in MRI- MR angiography, MR spectroscopy, Fmri.

PART - A

Q. No	Questions	BT Level	Competence
1	Define the principle of MRI	BTL1	Remembering
2	Define the principle of FMRI	BTL1	Remembering
3	Describe the clinical relevance of MRI	BTL1	Remembering
4	Show how stroke can be viewed using MRI system	BTL3	Applying
5	Illustrate the capability of MR image	BTL3	Applying
6	Illustrate the significance of Bloch equation	BTL3	Applying
7	Define the phenomenon of nuclear magnetism	BTL1	Remembering
8	Mention the significance of gyromagnetism	BTL1	Remembering
9	Define the concept of precession used in MRI	BTL1	Remembering
10	Tabulate the various gyrometric ratios	BTL4	Analyzing
11	Illustrate the importance of Larmor frequency	BTL4	Analyzing
12	Assess the importance of magnetic susceptibility	BTL5	Evaluating
13	Summarize the principle of reciprocity	BTL5	Evaluating
14	Formulate the transverse component of magnetization	BTL6	Creating
15	Formulate the longitudinal component of magnetization	BTL6	Creating
16	Arrange the factors that has direct implication on Bloch equations	BTL4	Analyzing
17	Describe the significance of magnetic susceptibility	BTL2	Understanding
18	What is the importance of chemical shift?	BTL2	Understanding
19	Mention the importance of faraday law of induction	BTL2	Understanding
20	Define the phenomenon of free induction decay	BTL2	Understanding

PART – B

1	Explain the concept of microscopic magnetism in MRI (13)	BTL2	Understanding
2	Assess the concept of macroscopic magnetism in MRI (13)	BTL5	Evaluating
3	Discuss the various aspects presession and Larmor frequency (13)	BTL2	Understanding
4	Examine the significance of NMR signals (13)	BTL1	Remembering
5	Contrast between transverse and longitudinal magnetization in MRI system (13)	BTL4	Analyzing

6	Illustrate the concept of rotating frames in NMR (13)	BTL3	Applying
7	Draw and explain the importance of RF excitation (13)	BTL3	Applying
8	Generalize and draw the phenomenon of spin echoes (13)	BTL6	Creating
9	Analyze the various steps involved in p weighted contrast mechanism (13)	BTL4	Analyzing
10	Explain in detail the Bloch equations used in NMR (13)	BTL1	Remembering
11	Enumerate the various biological effects of NMR (13)	BTL1	Remembering
12	Enumerate the various advantages of NMR (13)	BTL2	Understanding
13	Describe various steps in a t1 weighted contrast method (13)	BTL1	Remembering
14	Analyze the various sequence involved in t2 weighted contrast technique (13)	BTL3	Analyzing
	PART - C		
1	Integrate various different components used in NMR to build a MRI system (15)	BTL 6	Creating
2	Assess the principle of NMR system with a FID Fourier transformation (15)	BTL 5	Evaluating
3	Summarize the following with a neat diagram (i) Discrimination based on relaxation rates (8) (ii) Types of imaging sequence (7)	BTL 5	Evaluating
4	Formulate and prepare various image reconstruction techniques used in NMR (15)	BTL 6	Creating

UNIT - IV RADIO ISOTOPIC IMAGING AND INFRARED IMAGING

Radio nuclides for imaging -Rectilinear scanners – linear scanners – Gamma camera – Emission computed tomography- SPECT, PET- Physics of thermography – imaging systems – pyroelectric vidicon camera clinical, thermography – liquid crystal thermography.

PART – A

Q. No	Questions	BT Level	Competence
1	Mention the significance of radio tracers	BTL1	Remembering
2	Define atomic, mass number	BTL1	Remembering
3	Define isobars, isotones	BTL1	Remembering
4	Mention the importance of mass defect with example	BTL3	Applying
5	Illustrate graphically average binding energy as a function of nuclide	BTL3	Applying
6	Illustrate the significance of nuclide and radio nuclide	BTL3	Applying
7	Define the phenomenon of binding energy	BTL1	Remembering
8	Mention the significance of line of stability	BTL1	Remembering
9	Define the concept of radioactivity with example	BTL1	Remembering
10	Arrange and order various modes of decay	BTL4	Analyzing
11	Illustrate the importance of positron decay	BTL4	Analyzing

12	Assess the importance of electron capture	BTL5	Evaluating
13	Summarize the importance of isometric transition	BTL5	Evaluating
14	Formulate the statistics of decay	BTL6	Creating
15	Formulate the effective half-life of radio tracers	BTL6	Creating
16	Analyze the importance of main particulate radiation	BTL4	Analyzing
17	Describe the classes of ionization radiation	BTL2	Understanding
18	Examine the reason for terming nuclear medicine imaging as emission imaging	BTL2	Understanding
19	Point out the importance of Infrared radiation	BTL2	Understanding
20	What are the physical factors of IR radiation?	BTL2	Understanding
	PART – B		
1	Explain the construction and working principle of Anger Scintillation camera (13)	BTL2	Understanding
2	Assess various different features of Collimators used in nuclear medicine imaging systems (13)	BTL5	Evaluating
3	Discuss the various aspects of attenuation and scatter in PET and SPECT (13)	BTL2	Understanding
4	Examine the significance of a gating system used in nuclear medicine imaging system (13)	BTL1	Remembering
5	Analyze the image capture mechanism used in nuclear medicine imaging system (13)	BTL4	Analyzing
6	Illustrate the following with a neat diagrams (i) Photo multiplier tube (5) (ii) Scintillation crystal(4) (iii) Positioning logic (4)	BTL3	Applying
7	Draw and explain the working principle of solid state and other new cameras (13)	BTL3	Applying
8	Generalize the estimation principle of the following image reconstruction techniques (i) Algebraic Reconstruction Technique (ART) (7) (ii) Maximum Likelihood by Expectation Maximization (6)	BTL6	Creating
9	Analyze the working principle of combined PET/CT system (13)	BTL4	Analyzing
10	Explain in detail the image quality in PET and SPECT (13)	BTL1	Remembering
11	Explain in detail the sensitivity in a nuclear medicine imaging system (13)	BTL1	Remembering
12	Describe in detail the significance of quantitative medial thermography (13)	BTL2	Understanding
13	Describe various blocks available in a Pyro electric Vidicon camera with a neat block diagram (13)	BTL1	Remembering

14	Analyze the working principle of combined PET/MRI system (13)	BTL3	Analyzing
PART –C			
1.	Integrate various different components used to build a SPECT system (15)	BTL 6	Creating
2.	Assess the principle of IR thermography system with a neat block diagram (15)	BTL 5	Evaluating
3.	Summarize the image formation techniques in the following (i) SPECT (8) (ii) PET (7)	BTL 5	Evaluating
4.	Integrate various different components used to build a PET system (15)	BTL 6	Creating

UNIT V - ULTRASOUND, NEUROMAGNETIC IMAGING			
Ultrasound: Wave propagation and interaction in Biological tissues -Transducers and imaging systems- Imaging modes- Time required to obtain Images- System components, signal processing -dynamic Range- Ultrasound Image Artifacts- Quality control, Origin of Doppler shift- Limitations of Doppler systems. Neuromagnetic Imaging: Background.			
PART – A			
Q. No	**Questions**	**BT Level**	**Competence**
1	State the significance of echocardiogram	BTL1	Remembering
2	Mention the significance of Fetal ultrasound	BTL1	Remembering
3	Highlight the important property of ultrasound	BTL1	Remembering
4	Write the principle of production of ultrasound	BTL3	Applying
5	Classify the various biological tissues based on its ultrasound properties	BTL3	Applying
6	Illustrate the significance of 3D acoustic waves	BTL3	Applying
7	Define the phenomenon of spherical waves	BTL1	Remembering
8	Mention the significance of acoustic energy	BTL1	Remembering
9	Define the concept of acoustic intensity	BTL1	Remembering
10	Arrange and order wave transmission at plane interfaces	BTL4	Analyzing
11	Illustrate the importance of beam width in ultrasound	BTL4	Analyzing
12	Assess the frequency dependence of various biological tissues	BTL5	Evaluating
13	Summarize the importance of axial and lateral resolution with diagram	BTL5	Evaluating
14	Compose the phenomenon of doppler effects for various different cases	BTL6	Creating
15	Write the phenomenon of doppler effect	BTL6	Creating
16	Analyze the importance of characteristic impedance	BTL4	Analyzing

17	Describe the wavelength and frequency of ultrasound	BTL2	Understanding
18	Examine the property of velocity of propagation	BTL2	Understanding
19	Tabulate the speed of ultrasound in various biological tissues	BTL2	Understanding
20	Explain the detection of ultrasound	BTL2	Understanding
	PART – B		
1	Explain the significance of damping and matching in ultrasound systems (13)	BTL2	Understanding
2	Assess various different types of transducers used in ultrasound systems (13)	BTL5	Evaluating
3	Discuss the piezoelectric behavior of ultrasound crystal with a neat diagram (13)	BTL2	Understanding
4	Examine the significance of A-scan mode used in ultrasound imaging system. (13)	BTL1	Remembering
5	Analyze the various different ultrasound probes used in ultrasound imaging system (13)	BTL4	Analyzing
6	Illustrate the following with a neat diagrams (i) M-scan (3) (ii) B-scan mode (10)	BTL3	Applying
7	Draw and explain the working principle of 3 D ultrasound imaging technique (13)	BTL3	Applying
8	Generalize the occurrence of noise and speckle in the following (i) Electronics noise (7) (ii) Compound Scanning for Speckle Reduction (6)	BTL6	Creating
9	Analyze the working principle of combined PET/CT system (13)	BTL4	Analyzing
10	Explain in detail the image quality in ultrasound imaging (13)	BTL1	Remembering
11	Explain in detail the following in a ultrasound imaging system (i) Frequecny (ii) AED (iii) Focussing	BTL1	Remembering
12	Describe in detail the significance of medical ultrasound (13)	BTL2	Understanding
13	Describe working principle of echo-ophthalmoscope (13)	BTL1	Remembering
14	Analyze the working principle of echo cardiograph circuit with block diagram (13)	BTL3	Analyzing
	PART – C		
1	Integrate various different components used in a real time ultrasonic imaging system. (15)	BTL 6	Creating
2	Assess the principle of linear scanners with phased array systems (15)	BTL 5	Evaluating
3	Assess the principle of Duplex scanners with area array systems (15)	BTL 5	Evaluating
4	Integrate various different components used to build a digital scan converter system and biological effects of ultrasound (15)	BTL 6	Creating