

Answer Key – 19BMB304: Biomedical Image Processing (Set B)

Part – A ($5 \times 2 = 10$ Marks)

1. 1. Outline Medical Imaging Modalities:

Modalities include X-ray, CT, MRI, Ultrasound, PET, and SPECT. Each uses different physics principles for visualization.

2. 2. What do you mean by ionizing radiation?

Ionizing radiation refers to radiation with enough energy to remove tightly bound electrons from atoms, creating ions (e.g., X-rays, gamma rays).

3. 3. Recall Computer Aided Diagnosis (CAD):

CAD uses computer algorithms to assist radiologists in interpreting medical images for early disease detection.

4. 4. Define Molecular Imaging:

A technique to visualize, characterize, and measure biological processes at the molecular and cellular levels in humans and other living systems.

5. 5. List the applications of biomedical images:

Diagnosis, surgical planning, therapy monitoring, image-guided interventions, and disease progression tracking.

Part – B ($2 \times 13 = 26$ Marks)

6. 6. (a) Compare ionizing vs. non-ionizing imaging:

Ionizing Imaging: Includes X-ray, CT, nuclear imaging; uses radiation that can ionize tissues.

Non-ionizing Imaging: MRI, ultrasound; safer for repeated use.

Clinical Usage: Ionizing preferred for bone and dense structures; non-ionizing for soft tissues.

Elements Used: X-ray (iodine, barium), MRI (hydrogen nuclei), ultrasound (echo patterns).

7. 6. (b) Challenges in image reconstruction for CT and MRI:

Artifacts, noise, motion blur, incomplete data.

Strategies: Iterative reconstruction, motion correction algorithms, use of AI for denoising,

optimizing acquisition parameters.

8. 7. (a) Tumor detection in lung CT:

Techniques: Thresholding, region growing, morphological operations, segmentation, edge detection, machine learning.

Early-stage detection focuses on identifying nodules, texture analysis, and contrast enhancement.

9. 7. (b) Molecular imaging in cancer therapy:

Uses PET, SPECT to target specific biomarkers.

Enables patient-specific treatment decisions.

Monitors treatment response and disease progression.

Part – C (1 × 14 = 14 Marks)

10. 8. (a)(i) PACS with Cloud-based Telemedicine:

Performance: Enhances data access, remote diagnosis.

Security: Concerns include data breaches, HIPAA compliance.

Scalability: Must handle high volumes, integrate AI tools, and ensure latency-free access.

11. 8. (a)(ii) Differentiating breast lesions using texture features:

Steps: Image pre-processing → ROI extraction → Feature extraction (GLCM, LBP) → Classification (SVM, ANN) → Diagnosis.

12. 8. (b)(i) Techniques for chest X-ray clarity:

Methods: Image enhancement, histogram equalization, contrast-limited adaptive histogram equalization (CLAHE), deep learning-based denoising.

Effectiveness: Enhances visibility, improves diagnosis accuracy especially for pneumonia.

13. 8. (b)(ii) DSA image processing for stenosis:

Steps: Image acquisition → Background subtraction → Filtering → Contrast enhancement → Edge detection → Quantitative analysis of vessel narrowing.