

Ref. No. : Ex/PG/BME/PE/T/115B/2025

MASTER OF BIO-MEDICAL ENGINEERING FIRST YEAR FIRST SEMESTER - 2025

MEDICAL IMAGING AND IMAGE PROCESSING

Time: 3 h

Full Marks: 100 (50 marks for each part)

Use separate answer script for each part.

Part I

Answer any two questions:

2 X 25 = 50

1. Differentiate between binary image and gray scale image. Explain components of general purpose image processing system. Define brightness, hue, saturation and chromacity.

5+10+10=25

2. Write short notes on : (any 2)

$2 \times 12\frac{1}{2} = 25$

- i. Sobel operator for edge detection
- ii. Image sampling
- iii. Image quantization

3. Write short notes on : (any 2)

$2 \times 12\frac{1}{2} = 25$

- i. Low pass filters, High pass filters
- ii. Discrete cosine transforms on image
- iii. Walsh-Hadamard transform on images

4. What is Frequency domain? Describe general procedure for filtering in Frequency domain. Differentiate between blurring and sharpening.

5+10+10=25

5. When do we need smoothing filter? Explain global and adaptive thresholding techniques. Describe RGB color model with proper diagram.

5+15+5=25

[Turn over

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Part-II

Answer total of 50 marks from the following

1. A biomedical implant antenna operates at a frequency of 915 MHz inside human tissue with a relative permittivity of $\epsilon_r = 49$. Find the wavelength (λ) of the electromagnetic waves inside the human body. (6)
 2. a) What are the functions of human implant antennas? (8)
b) Explain five of its applications. (6)
 3. Explain computer axial tomography (CAT) in detail with block diagram. (15)
 4. Explain "Ultrasound Imaging" system with block diagram. (10)
 5. Write short notes on: (any three) (5 X 3)
 - a) CCD sensor applications in different areas – discuss
 - b) Breath analyzer
 - c) X-ray imaging showing X-ray tube construction
 - d) Piezoelectric crystal effect
 - e) Annihilation event in PET
 6. Describe "Radio Frequency" pulse and relaxation event in MRI. (10)
 7. Comparison between X-ray and MRI – Discuss in detail. (10)
 8. A microscope has an objective lens with a focal length of 5 mm and an eyepiece with a focal length of 25 mm. If the length of the microscope tube is 160 mm, calculate the magnification of the microscope. (10)
 9. A breath alcohol testing machine using infrared spectroscopy measures the absorbance of ethanol in a breath sample. The amount of infrared light absorbed follows the Beer-Lambert law. Find the concentration C of ethanol in breath sample. (10)
- Given data:
- # I_o = Incident light = 100 units
 - # I = Transmitted light = 20 units
 - # ϵ = Molar absorption of ethanol = 2300 L/mol/cm
 - # L = Path length = 10 cm