MASTER OF BIO-MEDICAL ENGINEERING

FIRST YEAR SECOND SEMESTER EXAM 2024

MEDICAL IMAGING AND IMAGE PROCESSING

PG/BME/T/129A

Time : Three hours **Full Maks : 100**

(50 Marks for each Part)

Use separate answer script for each Part

Part - I (Image Processing)

Answer any 2 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) $2X12\frac{1}{2}=25$
   i. Sobel operator for edge detection
   ii. Image sampling
   iii. Image quantization
3. Write short notes on : (any 2) $2X12\frac{1}{2}=25$
   i. Histogram Equalization
   ii. Discrete cosine transforms on image
   iii. Walsh-Hadamard transform on images
4. What is Frequency domain? State properties of Fourier Transformation. Differentiate between blurring and sharpening. 5+10+10=25
5. When do we need smoothing filter? Describe general procedure for filtering in Frequency domain. Describe RGB color model with proper diagram. 5+15+5=25

[Turn over

Ex/PG/BME/T/129A/2024

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(1st Year, 2nd Semester)

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(50 marks for each Part)

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PART - II

Answer ***a total of 50 marks*** from the following

1. A digital camera captures a 200 x200 pixels image of a black and white football on a grey background. The ball is 30cm in diameter and is 150 cm away from the camera. The camera has a field of 90 degrees horizontally and vertically .What is the diameter of the ball in pixels? [15]

2. (a) Suppose that an image of dimension 4x6 inches has frequency of 300dot/inches in each direction. How many samples are required to preserve the information in the image? [10]

(b) Describe charged coupled (CCD) image sensor listing four (4) major activities. What are photosites? [8+2]

3. (a) Describe magnetic resonance imaging (MRI)with block diagram of MRI system [17]
(b) How many bits required to store a 256 x256 images with 32 grey level? [3]

4. The image: $f(x,y)=4\cos(4\pi x).\cos(4\pi y)$is sampled with $\Delta x= \Delta y=0.5$.The sampled image is reconstructed with an ideal low pass filter with cut off frequency of $\pm 1/2\Delta x$ and $\pm 1/2\Delta y$.Find reconstructed image. [20]

5. Describe tracer distribution and annihilation event in positron emission tomography. [10]

6. Describe ultrasound in details with block diagram. [20]

7. Write short notes on any two: [10 x 2]
(a) Piezoelectric crystal used in ultrasound (b) CCD sends (c) X-ray tube (d) Microscope

8. What is catheter angiography explain with block diagram. [20]

9. A sphere of radius =1 meter is projected onto an image. The camera has a focal length of 10 mm, and each pixel corresponds to 0.01 mm on the image plane. The sphere projects to a circle of radius =20 pixels on the image plane .How far is the sphere from the camera? [30]

10. Discuss the various applications of digital image processing. How a car senses the image. [10]

11. Describe Human eye and how image forms in the retina .Explain with structure of eye .What is dim light vision? [10+5]

12.Consider a check board image in which each square is 1 x1 mm. Assuming that image extends infinitely in both co-ordinates direction, what is the minimum sampling rate (in samples/mm)required to avoid aliasing ? [15]

13. What are the difference between image formation in the photographic camera and human eye? [10]