
 Mansoura University	 Faculty of Engineering	Biomedical Engineering (BME) Program Time allowed: 2 Hours Exam is 4 pages Assume any missing data Include and name all steps
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Q.1 Fill the table below using short notes (5 points)

	Magnetic Resonance Imaging	Nuclear Imaging
How the image is formed?		
Radiation (invasive or not)		
One application		

Q.2 Sketch a typical arrangement of an X-ray scanner (5 points)

Sketch:

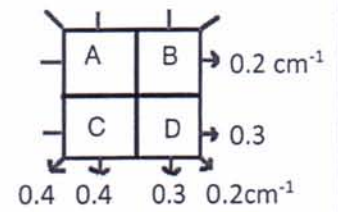
Applications:

Q.3 For a 20x20 test X-ray image with two classes: Kidney and background. The **joint probability** for a pixel to have grey levels ($q=0$ or 1 or 2) and to be a kidney pixel is $p(y=q, x=\text{kidney})=[0.15 \ 0.15 \ 0.15]$, and to be a background is $p(y=q, x=\text{background})=[0.5 \ 0.1 \ 0.1]$. Fill below: (5 points)

- The prior probability for the pixel to be a background =.....
- Number of kidney pixels in the test image=
- Number of the pixels in the test X-ray image with a grey level $q=1$ is.....
- Bayes classifier rule for classification is.....
- Based on Bayes classifier, pixels with grey level values of will be classified as kidney

Q.4 If CT attenuation projections of a cross-section is shown below. Compute the **Hounsfield units** for the tissues (A, B, C and D) using the **iterative reconstruction technique**. (5 points)

Note: Attenuation coefficient of water = 0.2 cm^{-1}



Q.5 Illustrate in details the M-mode ultrasonic device giving one application

(5 points)

Q.6 A Pulse mode doppler (PMD) transducer emits two ultrasonic pulses with a frequency of 1 MHz through the body and receive back-echoes with frequencies of 1.2 MHz and 0.8 MHz. If the Ultrasonic speed is 1500 m/s. Determine the speed of the blood cells for each echo and whether they approaches or departs from the transducer. Mention one advantage of using PMD (5 points)

Q.7 Define half life and half value layer and how they affect nuclear imaging (5 points)

Q.8 Compute the distance map of the following segmented registered training image, where '1' indicate an object and '0' indicates background (5 points)

0	0	0	0	0
0	1	1	0	0
0	1	1	1	0
0	0	1	1	0
0	0	0	0	0

Q.9 Using the expectation-Maximization algorithm (EM algorithm), the E-step responsibilities for 2x3 image were calculated below. Compute the M-step. (i.e., find updated prior portability, updated mean and variance for both the object and background distributions) (5 points)

Image, Y			$\pi(x = 0 Y)$		
7	5	4	1	1	0.8
3	2	1	1	0.2	0.5

Q.10 Draw the main component of MRI scanner and mention the job of each component (5 points)

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خالص امنياتي بالتوفيق

تمت الاسئلة