ELE 588 Biomedical Engineering I Exam #1 Fall 1999 Name: _____

Open book/note. Each question is worth 10 points.

1. ( ) What can we say for sure about a photon with an energy of 100 KeV? (A) It's an x-ray photon. (B) It's a gamma-ray photon emitted from a radioactive isotope. (C) Its wavelength is 124 Å. (D) It's weight is $(1.6 \times 10^{-19}) / c^2$ Kg, where c is the speed of light. (E) none of the above.

2. ( ) Which of the following statements regarding medical imaging history is not correct? (A) The discovery of x-rays in 1895 is considered the beginning of the modern history of medical imaging. (B) The principle of nuclear magnetic resonance was discovered about the same time when the first electronic computer was built. (C) The first commercial x-ray CT system was available in the early 1970's. (D) The first commercial single photon emission computed tomography (SPECT) system was available in the late 1970's. (E) none of the above (i.e. all of the above are correct).

3. ( ) Which of the following elements are often used as the target materials in x-ray tubes? (A) Au and Ag, (B) Mo and W, (C) Cu and Al, (D) Co and Gd, (E) none of the above.

4. ( ) Which of the follow compounds/elements has not been used for the purpose of x-ray detection? (A) AgBr, (B) CsI, (C) CF_3Br, (D) Xe, (E) none of the above (i.e. all of the above have been used).

5. ( ) A digital x-ray image is obtained by use of a video camera focused on the x-ray image intensifier. The detector quantum efficiency (DQE) is 0.6 for both the image intensifier and the camera system. The signal to noise ratio (SNR) just before the x-rays hit the image intensifier is 10. What is the SNR of the digital image? (A) 2, (B) 4, (C) 6, (D) 8, (E) none of the above.

6. ( ) The geometric unsharpness (Ug) is caused by the finite focal spot size. In an x-ray system the distance between the x-ray tube and the image plane is 4 m. When the object is placed 1 m from the x-ray tube, Ug is determined to be 0.6 mm. When the object is placed 3 m from the x-ray tube, Ug is determined to be 0.2 mm. What is the size of the focal spot? (A) 0.4 mm, (B) 0.6 mm, (C) 0.8 mm, (D) 1.0 mm, (E) none of the above.

7. ( ) Small-angle fan-beam geometry for tomographic reconstruction was first introduced in (A) the 1st generation CT, (B) the 2nd generation CT, (C) the 3rd generation CT, (D) the 4th generation CT, (E) none of the above.

8. ( ) Which of the following statements best characterizes the essence of the Central Slice Theorem for tomographic reconstruction? (A) The projection at angle φ is the same as the slice at angle φ through the center of the image obtained by backprojecting the projections. (B) The 1-D Fourier Transform of the projection at angle φ is the same as the slice at angle φ through the origin of the 2-D Fourier Transform of the image to be reconstructed. (C) The 2-D Fourier Transform of the projections is the same as the 2-D Fourier Transform of the image to be reconstructed. (D) The slice at angle φ through the center of the image to be reconstructed is the same as the 1-D Fourier Transform of the projection at angle φ. (E) none of the above.

9. ( ) For the convolution backprojection algorithm the filter applied to the projection data is a (A) low-pass filter, (B) band-pass filter, (C) high-pass filter, (D) band-stop filter, (E) none of the above.

10. ( ) Which of the following statements regarding the Algebraic Reconstruction Technique (ART) is not correct? (A) ART is an iterative procedure. (B) The backprojection of the projection data can be used as the initial condition. (C) The difference between the projections of the current reconstructed image and the original projections is used to improve the reconstructed image. (D) It is guaranteed that the ART always converges. (E) none of the above.