ELE 588 Biomedical Engineering Exam #2 Fall 1998 Name: _____

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

1. ( ) Which of the following is the main consideration in designing the collimator of a γ-camera? (A) tradeoff between the number of photomultiplier tubes and the accuracy of the position sensitive network, (B) tradeoff between the signal to noise ratio and the ability to reject scattered photons, (C) tradeoff between the detector quantum efficiency and the photon energy, (D) tradeoff between the temporal resolution and the spatial resolution, (E) none of the above.

2. ( ) The major advantage of PET over SPECT is concerned with the fact (A) that two photons imply doubling the signal to noise ratio, (B) that the photons generated by annihilation in the PET system are much easier to detect, (C) that the detection of two photons traveling in opposite directions improves spatial resolution significantly, (D) that PET requires isotopes prepared in a cyclotron, (E) none of the above.

3. ( ) Hypothetically, in 2001 Dr. Sun discovers an isotope that emits an s^+ particle (named after his dog Shin Shin). The s^+ particle has a rest mass of 3×10^{-31} Kg. Shortly after its emission the s^+ particle encounters an s^- particle with the same mass. An annihilation takes place and all mass is converted to energy. Two photons are generated and travel in the opposite directions. The energy of each photon should be (A) 169 KeV, (B) 282 KeV, (C) 397 KeV, (D) 511 KeV, (E) none of the above.

4. ( ) In an ultrasound imaging system the dynamic range of the analog voltage output (i.e. A scan) is 30 dB. To cover this dynamic range sufficiently, what is the minimum number of bits required for the analog-to-digital conversion? (A) 5 bits, (B) 6 bits, (C) 7 bits, (D) 8 bits, (E) none of the above.

5. ( ) The maximum depth of tissue to be imaged by an ultrasound imaging system is determined to be 15 cm. Assume that the speed of sound in tissue is 1500 m/s. What is the maximum pulse repetition rate (PRR) that can be used? (A) 3750 Hz, (B) 5000 Hz, (C) 7500 Hz, (D) 9000 Hz, (E) none of the above.

6. ( ) For the above system each B-mode scan consists of 100 angles (a single scan line is obtained at each angle during one PRR cycle). What is the maximum frame rate? (A) 30 frames/s, (B) 50 frames/s, (C) 60 frames/s, (D) 75 frames/s, (E) none of the above.

7. ( ) By use of 2-D echocardiography and color Doppler flow imaging we observe a jet flow from the left ventricle into the left atrium during systole. This jet flow is an indication of (A) mitral stenosis, (B) mitral regurgitation, (C) aortic stenosis, (D) aortic regurgitation, (E) none of the above.

8. ( ) Determine the Larmor angular frequency for a dipole which has a mass of 1.67×10^{-27} Kg, carries a charge of 1.6×10^{-19} coulombs, and is under the influence of a uniform 1-Tesla magnetic field. (A) 47.9×10^6 radians/s, (B) 52.3×10^6 radians/s, (C) 61.0×10^6 radians/s, (D) 68.4×10^6 radians/s, (E) none of the above.

9. ( ) In the MRI system the echo created by a 180-degree pulse following a 90-degree pulse (the spin-echo pulse sequence) is the result of (A) free induction spin, (B) interaction between T_1 decay and T_2 decay, (C) dephasing of the dipoles, (D) rephasing of the dipoles after dephasing, (E) none of the above.

10. ( ) Which of the following algorithm is used to form the MRI image from the broad-spectrum RF signals received in the MRI system? (A) convolution backprojection, (B) algebraic reconstruction, (C) Fourier transform, (D) low-pass filtering, (E) none of the above.