Answer all questions. All questions carry equal points. ***Please be legible and show proper working and units, otherwise you are liable to lose credit****. All parts of a question should be answered together.* ***By taking this test, you agree to and conform to the Student Honor Code.***

1. Consider an industrial X-ray equipment being used to check the structural integrity of concrete pillars. Compute the effective depth given that f=5MHz, μ_r=1, ε_r=150, $\sigma=10^{-4}$ S/m. Also compute the effective depth if a site worker is accidentally exposed to the radiation. Assume average human body μ_r=1, $\sigma=10^{-1}$ S/m.

2. Consider a subject undergoing EST (Electro Shock Therapy). Assume that there is one electrode which has a diameter of 1cm. The current injected at the electrode-skin interface is 100mA and it varies as $i(x) = 100e^{-x}\ mA$; where *"x"* is the depth from the interface. Assuming a trapezoidal conic volume which has a depth of 5cm and a base diameter of 5 cm, compute the net power dissipated in this volume. You may take the resistivity to be uniform at 10Ω-cm.

3. Define and briefly explain the following terms:

   a. Skin Depth.
   b. Afferent Nerves.
   c. Efferent Nerves.

   Also compute the short circuit current when a human being with a height of 2 m, and an effective radius of 0.2m is subjected to a 10MHz electric field of magnitude 10V/m. Assume the subject is standing on the ground.

4. A MRI machine scans using the *y-z-x* schema. If the maximum number of voxels in the volumetric dataset are Y_{max}, Z_{max} & X_{max} respectively, write an algorithm to map a given voxel to its spatial coordinates. Also write the algorithm to map the voxel coordinate to its index.