(1) Describe the following terminologies:(25%)
(a) Gaussian surface, (b) Poynting vector, (c) Quasi-static conditions,
(d) Cavity resonator, (e) Stokes's theorem.

(2) Two identical coaxial coils, each of N turns and radius b, are separated by a distance d as shown in Figure 1. The current I_1 and I_2 for the left and right coils are in the same direction. Find the magnetic flux density along the x axis from x=0 to x=d.(15%)

(3) In the body composition study, the body is usually considered as two parallel cylinders for the fat and free-fat mass parts, respectively, as shown in Figure 2. If the conductivity for the fat is constant as σ_0, and the conductivity for the free-fat mass $\sigma=\sigma_1(1+K/z)$. Determine the resistance between the two electrodes.(15%)

(4) A student uses a long solenoid with iron core shown in Figure 3 as a force sensor for measuring the drag force. The current flowing in the coil is I and the number of the closely wound coil-turns per unit length is n. The cross-sectional area of this iron core is A and the permeability μ. Determine the force acting on the core as a function of x, and find the measurement limits for the force.(15%)

(5) The electrocardiogram shows the functional activity of the heart. If the bioelectricity for the heart can be considered as a dipole varying with time ($\vec{p}(t)$), find the potential between position 1 and 2 as shown Figure 4.(15%)

(6) In the technique of Magnetic Resonance Imaging (MRI), the gradient for the magnetic field with radio frequency along some direction is very important. Can you design a system to generate it? Describe your idea based upon the electromagnetic theory.(15%)

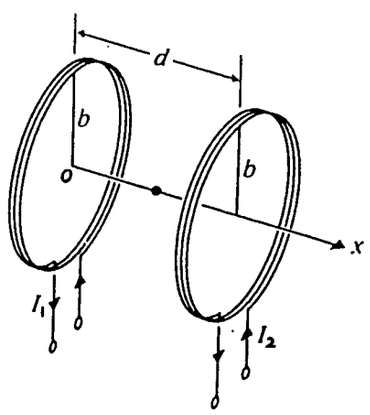

Figure 1

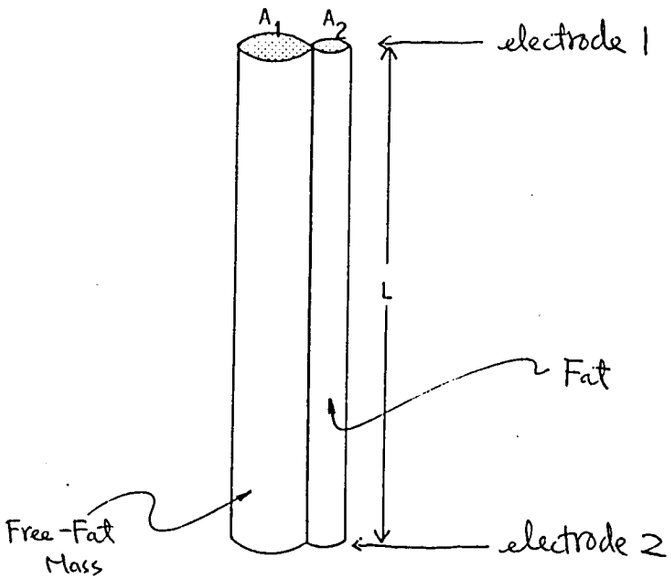

Figure 2

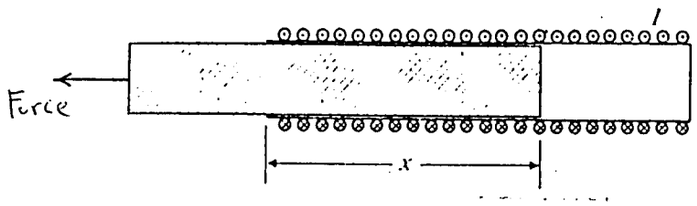

Figure 3

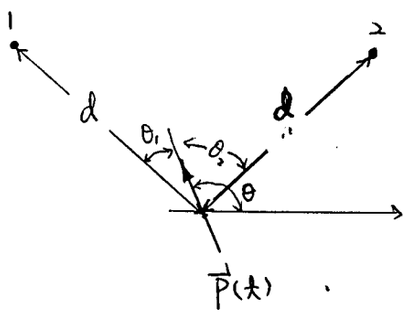

Figure 4