1. A charge density of $(c/r^2)\sin^2\phi$ (C/m^3) for particles uniformly distributed between two concentric spheres of radii 1 and 4 cm. Find the total charge contained in this region.(15%)

2. A constant voltage V_0 is applied to partially filled parallel-plate capacitor shown in Fig. 1. The permittivity of the dielectric is ε, and the area of the plates is S. Find the force on the upper plate.(15%)

3. Two grounded, semi-infinite, parallel-plane electrodes are separated by a distance b, and third electrode perpendicular to and insulated from both is maintained at a constant potential V_0 as shown in Fig. 2. Determine and Draw the potential distribution in the region enclosed by the electrodes.(20%)

4. Two coils of N_1 and N_2 turns are wound concentrically on a straight cylindrical core of radius a and permeability μ as shown in Fig. 3. The windings have lengths l_1 and l_2, respectively. Find the mutual inductance between the coils.(20%)

5. A sinusoidal electric intensity of amplitude 250 (V/m) and frequency 1 (GHz) exists in a lossy dielectric medium that has a relative permittivity of 2.5 and a loss tangent of 0.001. Find the average power dissipated in the medium per cubic meter.(10%)

6. Neglecting losses and fringe effects and assuming the substrate of a stripline to have a thickness 0.4 (mm) and a dielectric constant 2.25, (a) determine the required width of the metal strip in order for the stripline to have a characteristic resistance of 50 (Ω); (b) determine inductance and capacitance per unit length of the line; and (c) determine the velocity of propagation along the line.(10%)

7. Describe the basic principle for the ultrasound to measure the blood flow.(10%)

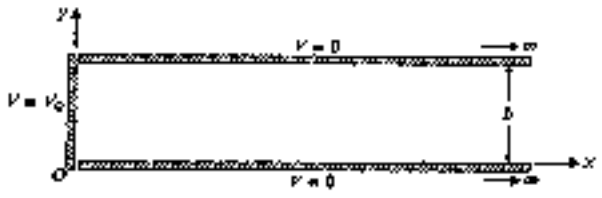

Fig. 2

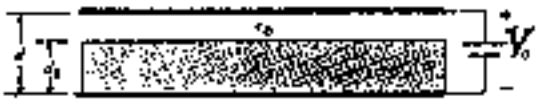

Fig. 1

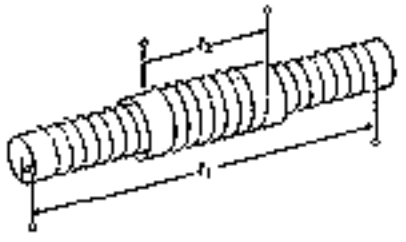

Fig. 3