1. Consider the electric potential (in spherical coordinates)

$$\Phi = \frac{a\sin\theta}{r^2} + \frac{b}{r}$$

where a and b are constants.

(a) Determine the electric field associated with this potential. (5%)
(b) What is the charge distribution responsible for this potential. (10%)
(c) Discuss the electrostatic energy for this charge distribution. (10%)

2. Two grounded conducting planes intersect at 90^0 and a point charge q lies between them.

(a) Determine the electric potential and the electric field everywhere. (10%)
(b) Determine the charge distribution on the planes. (5%)

3. A conducting spherical shell of radius R, carrying total charge Q, is set spinning at angular velocity ω about the z axis.

(a) What is the magnetic dipole moment of the spherical shell. (5%)
(b) Find the vector potential everywhere. (10%)
(c) Find the magnetic field inside and outside the sphere. (5%)

4. A square wire of width a in x-y plane is moving parallel to its width at a uniform speed v in y-direction. A very long wire carrying a stationary current I along the x-direction, is at distance d from the nearest side of the square wire.

(a) Determine the induced electromotive force (*emf*) in the square wire. (10%)
(b) Determine the mutual inductance of the circuits. (5%)

5. For a monochromatic plane wave has electric amplitude E_0, angular frequency ω and phase angle zero. If it is traveling in the y-direction and polarized in the z-direction.

(a) Write down the electric and magnetic fields. (10%)
(b) What are the energy density and the momentum density of the wave ? (10%)
(c) when it incident on a thick slab of conducting material, what happen ? (5%)