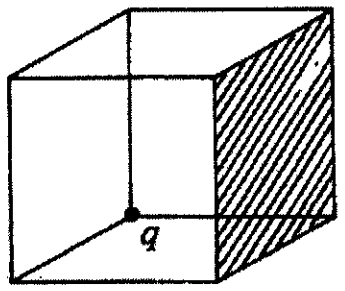
1. (a) Write down the differential form and integration form of the Gauss's law. What is the physical meaning of the Gauss's law?"(10%)
   (b) A charge q sits at the back corner of a cube, as shown in the figure below. Apply the Gauss's law to find the flux of electric field ($\int \vec{E} \cdot d\vec{a}$) through the shaded side surface. (see figure in below) (10%)



2. (a) Write down the differential form and integration form of the Ampere's law. What is the physical meaning of the Ampere's law? (10%)
   (b) Is the Ampere's law consistent with the general rule that divergence of curl is zero ($\nabla \cdot (\nabla \times \vec{v}) = 0$)? (hint: you can start from the differential form of the Ampere's law). Show that Ampere's law cannot be valid, in general, outside magnetostatics. (10%)
   (c) Is there any such "defect" in the other three of Maxwell's equations? (10%)

3. Explain the following terms briefly:
   (a) Smith chart (5%)
   (b) Wave impedance (5%)
   (c) Boundary conditions between two lossless media (5%)
   (d) Skin depth (5%)

4. Consider an incident beam passing from air into fused silica with an index of refraction n=1.46 at an angle of 60^0.
   (a) What is the polarization of the reflected beam if the electric field vector of the incident beam makes an angle of 45^0 with the plane of incidence? (10%)
   (b) At what angle of incidence will the reflected electric field be completely perpendicular to the plane of incidence? (10%)

5. Explain why single-conductor hollow or dielectric-filled waveguides cannot support TEM (transverse-electric and transverse-magnetic) waves. (10%)