國立中央大學九十一學年度碩士班研究生入學試題卷

所別: 太空科學研究所 不分組 科目: 電磁學 共 1 頁 第 1 頁
水文科學研究所 不分組

1.

Short questions and problems. (25%)

(a) Derive/write all six formulas interrelating between ρ, E and V.
(b) Write Poisson's and Laplace's equations; state the relationship between the two equations and the method of relaxation.
(c) Give the electrostatic and magnetostatic boundary conditions. Give the electrostatic boundary conditions at a conductor-free space interface.
(d) Write the differential form of Maxwell's equations.
(e) Write/state the point form for Ohm's law.
(f) Write the continuity equation.
(g) Express Lorentz's force equation.
(h) State plasma frequency.
(i) State Doppler effect.
(j) State wave guides, TE, TM, and Give an application in practice.

2.

(20%)

The earth is surrounded by an ionized shell, or ionosphere. Assuming the ionosphere is equivalent to a conducting shell at a height of h km. Let the earth radius be R_E and total charge deposited on the earth be $-Q$. Find (a) the electric filed intensity and flux density at $0<r<R_E$ and $R_E \leq r \leq R_E+h$. (b) Evaluate capacitance and (c) the energy of the earth-ionosphere combination. (d) Calculate the minimum value of the electric field intensity causing the space-to ground discharge.

3.

(15%)

The vector potential of the Earth is expressed as

$$A_{dip}(r) = \frac{\mu 0}{4\pi} \frac{m \sin\theta}{r2} \phi$$

(a) Find the magnetic filed $\boldsymbol{B}$ and, and (b) derive the magnetic filed line equation.

4.

(20%)

An a-c voltage of amplitude V_0 and angular frequency ω, $v_c = V_0 \cos \omega t$, is connected across a parallel-plate capacitor with an area A, plate separation, d, and a dielectric medium of permittivity ε. (a) Calculate the displacement current density. (b) Integrate it to get the total displacement current. (c) Find the magnetic filed intensity $\boldsymbol{B}$ at a distance r from the center axis of the capacitor. Evaluate the electric and magnetic energy within a distance b from the center axis of the capacitor.

5.

(20%)

A frequency 10 MHz radiowave is vertically transmitted into the ionosphere by an isolated Hertzian dipole. (a) If the dipole is made of a metal wire of radius a, length d and conductivity σ, find its radiation efficiency. (b)Write the source free wave equations for $\boldsymbol{E}$ and $\boldsymbol{H}$ in free space and the ionosphere. What's the major difference between the two? (c) Evaluate the forces of a free electron in the ionosphere applied by the $\boldsymbol{E}$ -and $\boldsymbol{B}$ -field of the radiowave.

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