

國立清華大學命題紙

八十九學年度第一學期 電機工程 電子工程 研究所 博士班研究生資格考試
科目 電磁理論 科號 _____ 共 2 頁第 1 頁 *請在試卷(答案卷)內作答

1. When we say that a dielectric material is a "linear" material, what do we mean in terms of dielectric constant of the material? And what does "nonlinear" material mean? (5%)
2. When we say that a dielectric material is "isotropic", what do we mean in terms of dielectric constant? And what does "anisotropic" material mean? (5%)
3. Explain why is the static electric field strength at an ideal metal surface has only the normal component? (5%)
4. Explain why that a sharp metal point has higher electric field strength than a flat metal surface if both are at the equal static electric potential. (5%)
5. Show that the energy dissipation for a ferromagnet to go through one complete cycle of the hysteresis loop is equal to the area of the loop. (10%)
6. An irregularly shaped hollow conductor is maintained at V_0 volts. If there are no charges inside the cavity region, what is the potential ϕ inside the cavity region? (5%)
7. Two semi-infinite conducting plate are arranged at a angle ϕ_0 . One plate is charged to 0 volts and the other to V_0 volts. A gap at the tip insulates one plate from the other. Find the potential Φ in the region between $0 < \phi < \phi_0$. (10%)
8. Study the following time-harmonic \vec{E} field in a source-free region:
$$\vec{E} = \hat{x}E_0e^{-jkx}$$

Does this field satisfy Maxwell's equations? If so find the k and the time-harmonic \vec{H} field. If not, explain why. (10%)
9. Write down the time-harmonic \vec{E} field for a circularly polarized wave. Show that a linearly polarized wave can be decomposed into two circularly polarized waves. (10%)
10. Consider a linearly polarized plane wave obliquely incident from one non-magnetic dielectric material into another. The dielectric constants are ϵ_1 and ϵ_2 respectively. The angle of incidence and transmission are θ_1 and θ_2 respectively.
 - (a) Please derive the reflection coefficients both for the TE- and TM- polarized light wave. (14%)
 - (b) Without using any mathematics, please discuss which state of polarization (TE or TM) can have a zero reflection. (3%)
11. Let us consider a z-directed rectangular metallic waveguide. To solve fields inside the waveguide, we use E_z and H_z formula, i.e. expressing other transverse electric and magnetic field components in terms of these two longitudinal components. Without using any mathematics, please explain why we don't use E_x and H_x , etc. formula. (6%)

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12. Let us consider signal transmission in two different coaxial cables in series. Thus, their impedances are mismatched. A current in the first transmission line is partially reflected when it reaches the interface of two transmission lines. From our understanding, a current is a collection of moving free electrons. Why are parts of these electrons reflected though we never apply an force on them? Please explain the true mechanism causing the above partial reflection. (6%)
13. Arranging antennas into an array is useful. Please briefly explain the functions of array antennas. (6%)