國 立 清 華 大 學 命 題 紙

八十五學年度 電機/電子 系(所) 丙 組碩士班研究生入學考試

科目 電磁學 科號 3103 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. (15%) Explain in detail, under static condition, why the electric field **E** inside a conductor is zero, why the surface of a conductor is an equipotential surface, and why the field **E** on that surface is everywhere normal to the surface.

2. (10%) Explain in detail why materials having high permeability and low conductivity are preferred as transformer cores.

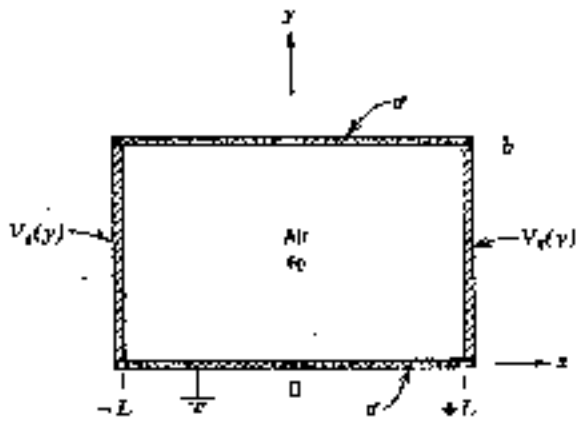
3. (10%) Show that $\nabla \times \nabla V = 0$ by integrating over an arbitrary surface and applying Stokes's theorem, where V is an arbitrary scalar function.

4. (15%) Sketch the magnitude of the reflection coefficient Γ versus incident angle θ qualitatively and mark the special incident angles for both parallel polarization and perpendicular polarization for the following two situations.
(a) A plane wave incident from air to a semi-infinite dielectric material with $\epsilon = 9\epsilon_0$
(b) A plane wave incident from a semi-infinite dielectric material with $\epsilon = 9\epsilon_0$ to air.

5. (15%) A rectangular air space is enclosed by two conducting plates (at $y = 0$ and b) and two distributed voltage sources (at $x = \pm L$) of the form (for $0 \leq y < b$)

$$V_s(y) = \frac{V_0 y}{b}, \qquad \text{at } x = \pm L$$

where V_0 is a constant. Assuming that this system is infinitely long in the z direction, find the potential ϕ within the enclosed air space.



6. (10%) Without resorting to the expressions of TE_{mn} and TM_{mn} modes of a rectangular waveguide, determine which mode (TE or TM) is the dominant mode of this waveguide.

7. (10%) The end of an Ethernet coaxial cable is usually connected to a component called terminator. Describe the purpose and the principle of the terminator.

8. (15%) A monostatic radar system uses the same antenna to transmit and receive microwave signals for the detection and ranging of a metallic target. The radar equation, which relates the received power P_r and the transmitted power P_t, reads as

$$\frac{P_r}{P_t} = \lambda^m r^n \cdot \frac{\sigma_{bs}}{(4\pi)^3} G_D^2(\theta, \phi),$$

where $G_D(\theta, \phi)$ is the directive gain of the antenna in the direction of the target and σ_{bs} is the radar cross section of the target at a distance r away. Without resorting to any expression, find the constants m and n in the radar equation. Give your reasons.