

元智大學 九十七 學年度研究所 碩士班 招生試題卷

系(所)別： 光電工程學系碩士班

組別： 不分組

科目： 電磁學

用紙第 | 頁共 | 頁

●不可使用電子計算機

本科試題若有題意不清的地方，可以自行假設條件。若懷疑題目有錯誤時，可以修正之，但須寫出題目需要修正的理由或觀點。監試人員可以不做任何題意的說明。

1. (10 points)

Find the directional derivative of $f = x^2y^2z^2 + x + y + z$ in the direction of the vector $2\mathbf{a}_x - \mathbf{a}_y + 2\mathbf{a}_z$ at the point (1, 1, 1), where \mathbf{a}_x , \mathbf{a}_y , and \mathbf{a}_z are the unit vectors along x-, y-, and z-axes, respectively.

2. (Total 20 points, each part 10 points)

An electric dipole can be defined as a pair of equal charges of opposite signs that are very close together. Assume that the magnitude of each charge is q and the separation between them is d . Define \mathbf{p} as a dipole moment vector with magnitude $p = qd$ and directing along the line from the negative to the positive charge such that $\mathbf{p} = qd\mathbf{a}_z$, where \mathbf{a}_z denotes the unit vector along z-axis. Now, we consider the problem of field quantities at any point $P(x, y, z)$ associated with a position vector \mathbf{r} relative to the center of the dipole. If the observation point P is quite far away such that $r \gg d$, determine (A) the electric potential and (B) the electric field at that point in terms of \mathbf{p} and \mathbf{r} .

3. (Total 20 points, part (A) 8 points, part (B) 6 points, part (C) 6 points)

A 5-cm-wide, 5-cm-long, and 1-cm-thick copper strip carry a current of 100 A is placed at right angles in a uniform magnetic field of 2.0 T. The conductivity of copper is 5.8×10^7 S/m and there are 8.5×10^{28} free electrons per cubic meter in copper. (A) Determine the Hall-effect voltage. (B) What is the Hall-effect electric field intensity? (C) What is the electric field intensity responsible for the current in the copper strip?

4. (Total 50 points, each part 5 points)

- (A) Describe skin depth qualitatively.
- (B) Define good dielectric mathematically.
- (C) Define good conductor mathematically.
- (D) Explain the perpendicular polarization qualitatively.
- (E) Explain the parallel polarization qualitatively.
- (F) Explain the Brewster angle qualitatively.
- (G) Explain Poynting's theorem either qualitatively or mathematically.
- (H) Define the reflection coefficient mathematically.
- (I) Explain cutoff frequency qualitatively.
- (J) Define standing wave ratio mathematically.