國立臺灣科技大學

115學年度碩士班招生

試題

系所組別：0762電機工程系碩士班己二組

科　　目：電磁學

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（總分為100分;所有試題務必於答案卷內頁依序作答）

(Total 100 points)

A. (30 points)

A time-harmonic plane wave with electric field in phasor form expressed as $\mathbf{a}_z 10e^{j100\pi x}$ (V/m) is propagating in vacuum, and normally incident onto a unknown material medium at x = 0 . The reflected wave is found to be $-\mathbf{a}_z 5e^{-j100\pi x}$ (V/m). Answer the following question:

1) (5%) Find the propagation direction of the incident plane wave.
2) (5%) Find the direction of magnetic field of the reflected wave in vacuum.
3) (5%) Find the reflection and transmission coefficients at the interface between vacuum and unknown material medium.
4) (5%) Determine the dielectric constant of the unknown material medium
5) (5%) Determine the operating frequency of the plane wave.
6) (5%) Determine the location(s) at which the summation of incident and reflected wave (i.e. total wave) reach the maximum.

B. (10 points)

A current *I* flows along a straight wire from a point charge $Q_2(t)$ located at the point (0,0,3) to a point charge $Q_1(t)$ located at origin and intersect the surface as shown in **Fig. 1**. At the intersection point, the solid angle looking to either charge is $\pi/2$ Steradian (Sr). Find the line integral of **H** around the contour C.

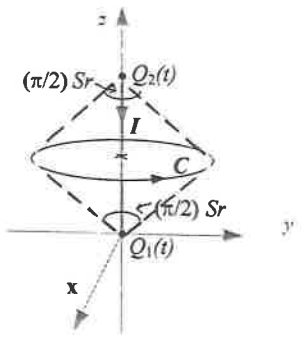

Fig. 1

C. (10 points)

A 10-kHz uniform plane wave propagating in a material medium has the following characteristics. (i) The fields are attenuated by a factor e^{-1} after propagating a distance of 100 m. (ii) The fields undergo a change of phase by 5 rad in a distance of 0.05 m. (iii) The relative permeability μ_r of the medium is 1. In your opinion, is the medium likely a perfect dielectric, an imperfect dielectric, a good conductor, or a PEC? WHY? Write down the formulae lead to your conclusion.

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D. (20 points)

For points on Smith Chart shown on the next page, assuming the characteristic impedance of the line is 60 Ω, find

(a) the reflection coefficient at Point A in polar form. (4%)
(b) the impedance at Point B. (4%)
(c) the standing wave ratio at Point A. (4%)
(d) the minimum transmission line length (in wavelength) required to move Point C to Point D when moving toward generator. (4%)
(e) the impedance becomes after connecting an open-ended stub of 0.25λ in parallel at the transmission line's end, which is terminated as Point E. (4%)

E. (14 points)

A 100-Ω transmission line of 30λ long is terminated by a load impedance Z_R = 25 Ω. If a time average power of 1 W is provided from the generator, determine how much time-average power is delivered to load for

(a) a lossless line; (6%)
(b) a lossy line of α = 0.005 NP/λ. (8%)

F. (16 points)

For following charges and displacements: -2Q at (0, 0, d/2), -Q at (0, 0 ,0), and 3Q at (0, 0, -d/2).

(a) Find the first significant term in the expression for the electric potential at distances far from the origin ($r >> d$) (10%) [Hint: use $r_1 \approx r - \frac{d}{2}\cos\theta$ $\quad$ $r_2 \approx r + \frac{d}{2}\cos\theta$]

(b) Find the electric field intensity due to above charge distribution via the gradient of the electric potential. (6%)

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The Complete Smith Chart

Black Magic Design