國立成功大學 104 學年度碩士班招生考試試題

系所組別：電腦與通信工程研究所丁組

考試科目：電磁波

考試日期：0211，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Problem 1: (20 Points)

Prove that (a) the four equations of Maxwell's equations are not totally independent, and (b) electromagnetic waves cannot penetrate a perfect conducting surface.

Problem 2: (20 Points)

On a transmission line, the voltage wave is given by $V(\ell)=120e^{0.0025\ell}\cos(10^8t+2\ell)+60e^{-0.0025\ell}\cos(10^8t-2\ell)$, where ℓ is the distance from the load $Z_L\left(=300\Omega\right)$. Find the attenuation constant α, propagation constant β, phase velocity υ_p, characteristic impedance Z_0, and the current wave $I(\ell)$.

Problem 3 (20 Points)

When a uniform plane wave in air is normally incident onto a planar lossless medium, the reflection coefficient is measured to be – 0.25, and the phase velocity of the transmitted wave is reduced by a factor of 3. Find (a) the relative permittivity and the relative permeability of this lossless medium. (b) Design a match layer before this medium to reduce the reflection to zero.

Problem 4 (20 Points)

(a) What is the maximum power that can be received over a distance of 1 km in free space with a 2.4-GHz circuit consisting of a transmitting antenna with a gain of 20 dB and a receiving antenna with a gain of 10 dB? The transmitted power is 1Watt. (b) What are the effective aperture and beam solid angle of the receiving antenna if it is lossless?

Problem 5: (20 Points)

A load consists of a variable L and R in series combination such that $|Z_L|=5$. It is connected to a transmission line with a characteristic impedance of 1 Ω as shown on next page. (a) Show the possible locations of this load on a Smith chart normalized to 1 Ω. (b) As one proceeds toward the generator, which does he or she encounter first, a voltage maximum or a voltage minimum? Show why.

A single short-circuited stub, with characteristic impedance of 1 Ω, is to be used for impedance matching by properly selecting the lengths d_1 and d_2. (c) What value of the load Z_L will require the shortest distance d_1 to the stub and then (d) what will be the length d_2 of the stub?

(Note: you may use the Smith chart on this page for your calculations, temporarily. But don't forget to plot simplified Smith charts on your answer sheets to show your important procedures and results. Otherwise they cannot be graded.)