國立成功大學

114學年度碩士班招生考試試題

編　號：137

系　所：電腦與通信工程研究所

科　目：電磁場與波

日　期：0210

節　次：第 2 節

注　意：1.可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

Problem 1 *(20 Points)*

(a) A circular cylinder along the z-axis has its $\mu_r = 100$ and a magnetic flux density $\vec{B}_{in} = 5\hat{a}_\varphi\ (T)$ inside. The exterior of the cylinder is air. Find the magnetic flux density just outside the cylinder $\vec{B}_{out}$.

(b) The $x = 0$ plane contains a current sheet of density $\vec{K}$ which separate region 1, $x < 0$ and $\mu_{r1} = 2$, from region 2, $x > 0$ and $\mu_{r2} = 7$, Given $\vec{B}_1 = 6\hat{a}_x + 4\hat{a}_y + 10\hat{a}_z\ (T)$ and $\vec{B}_2 = 6\hat{a}_x - 14\hat{a}_y + 21\hat{a}_z\ (T)$, find $\vec{K}$.

Problem 2 *(20 Points)*

Find the scalar potential ϕ and the electric field intensity $\vec{E}$ (for any time t), based on the *Lorenz condition*, if the vector potential is given in free space as $\vec{A} = \hat{a}_z(xz/c - xt)$, where c is the speed of light in free space, $\phi = xz$ and $\vec{E} = -\hat{a}_x z$ when $t = 0$.

Problem 3 *(20 Points)*

In a source-free dielectric medium ($\varepsilon = 9\varepsilon_0$, $\mu = \mu_0$), the magnetic field intensity is given as $\vec{H} = \cos(10^9 t - 3kx - 4kz)\hat{a}_y\ (A/m)$, where k is a constant. By using Maxwell's equations, find (a) the displacement current density, (b) the electric field intensity, (c) the constant k, (d) time average power per square meter in $+z$ direction.

Problem 4 *(20 Points)*

A 100-ohm transmission line is terminated at a load of 300 ohms. Find (a) the voltage reflection coefficient at the load location, (b) the VSWR on the line, (c) the voltage reflection coefficient and the input impedance $\lambda/8$ away from the load.

Problem 5 *(20 Points)*

An air-filled metallic parallel-plate waveguide, with the plate separation of $6\ cm$, has the magnetic field intensity as $\vec{H} = \cos(50\pi x)\cos(39\pi \times 10^9 t - \beta z)\hat{a}_y\ (A/m)$. (a) What is name of this mode? (b) What is the cutoff frequency of this mode? (c) What is the guide wavelength of this wave in the z-direction? (d) What is the group velocity of this wave?