國立成功大學

113學年度碩士班招生考試試題

編　號：182

系　所：電腦與通信工程研究所

科　目：電磁場與波

日　期：0201

節　次：第 2 節

備　註：可使用計算機

※ 考生請注意：本試題可使用計算機。 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)

Two conducting spheres are both centered at the origin. *Sphere 1* has the radius a and its potential is *1 volt*. *Sphere 2* has radius b ($b>a$) and is grounded (0 *volt*). Between the spheres is a medium with permittivity ε and conductivity σ. Please find (a) the *total electric charges* on *Sphere 1*, (b) the *electric flux density D* at any r, $a<r<b$, (c) the *electric current density J* at any r, $a<r<b$, and (d) the *resistance* between these two spheres.

Problem 2: (20 Points)

Consider the following complex phasor expression for a time-harmonic electric field in free space: $\bar{E}=\left(6\hat{a}_x+E_y\hat{a}_y-j10\hat{a}_z\right)e^{-j(16\pi x-12\pi y)}\,mV/m$ (a) What is the *frequency* and the *direction* of propagation, (b) the *value* of E_y, and (c) the state of *polarization*? (d) Find the associated *magnetic field.*

Problem 3: (20 Points)

An infinite-long lossless coaxial line, along the z-axis, can carry electromagnetic signals with velocity $\upsilon=10^8\,m/s$ and characteristic impedance $Z_0=50\,\Omega$. The incident *CURRENT*, coming from $z=-\infty$, is $I^+(z,t)=e^{j(\omega t-20\pi z)}A$. Find (a) the frequency of the signal, and (b) the inductance and (c) the capacitance per meter of the line. If the line for $z>0$ is now replaced by another lossless coaxial line with $Z_0=100\,\Omega$ and $\upsilon=2\times10^8\,m/s$, find (d) the transmitted *VOLTAGE* $V^+(z,t)$ for $z>0$.

Problem 4: (20 Points)

A 6.25 mm by 2.50 *mm* air-filled waveguide is required to introduce a signal *group delay* of 0.2 *ns* at 30 GHz using its fundamental mode. What are (a) the total wave number, (b) the wavelength in the propagation direction, (c) the group velocity, and (d) the required waveguide length in *mm*?

Problem 5: (20 Points)

A 100-ohm transmission line is terminated at a load of 80 - j160 ohms. Do all the following operations

and calculations **by only using a Smith chart**. (a) Find the location of this load on a Smith chart, (b) VSWR on the line, (c) the admittance of the load, and (d) the distance from the load to the first voltage minimum. (Note: Please plot *simplified Smith charts* on your answer sheets and explain your important *procedures* and *results*. **No points will be given if you only write down the final results on your answer sheets or if you solve these problems by other methods without using a Smith chart.**)