系所組別：電機工程學系甲組

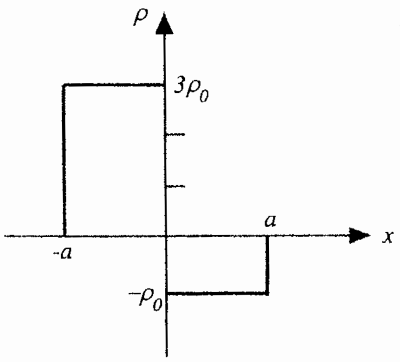
考試科目：電磁學

考試日期：0223，節次：2

※ 考生請注意：本試題可使用計算機

1. Answer the following questions.
   (a) [5 分] Define polarization vector and magnetization vector, respectively. What is the intrinsic impedance for a material medium?
   (b) [10 分] What are electromagnetic potentials? How do they arise? State Laplace's equation and Poisson's equation and give two cases to which the equation can be applied, respectively.
   (c) [5 分] What is the basis behind the construction of the Smith chart? Define the standing-wave ratio (SWR).
   (d) [6 分] What is the Q factor of a resonator? What are transverse elecric wave, transverse magnetic wave and hybrid wave in an optical waveguide?
   (e) [4 分] Define the radiation resistance and directivity of an antenna.

2. [18 分] The x-variation of charge density independent of y and z in free space is shown below. Find and sketch the resulting electric field E_x versus x.

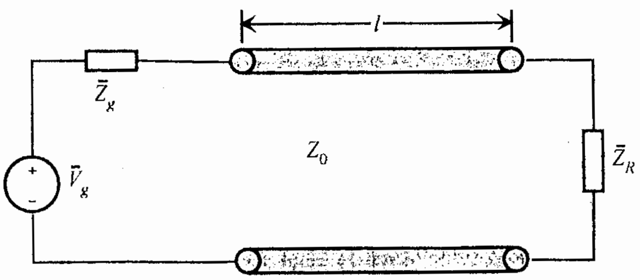


3. [18 分] The electric field of a uniform plane wave propagating in the $+z$-direction in a nonmagnetic material medium is given by

$$\mathbf{E} = 8.4e^{-0.0432z}\cos(4\pi \times 10^6 t - 0.1829z)\boldsymbol{a}_x \text{ V/m}$$

Find the magnetic field of the wave. Further, find the values of conductivity σ and permittivity ε of the medium.

4. [18 分] Consider the system shown below, where $\bar{V}_g = 100\angle 0^\circ$ V, $\bar{Z}_g = (10 + j10)\Omega$, $\bar{Z}_R = (30 + j40)\Omega$, and the length of the transmission line $l = 0.725\lambda$ with characteristic impedance of $Z_0 = 50\Omega$. Find the time-average power delivered to the load $\bar{Z}_R$.



(背面仍有題目,請繼續作答)

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5. [16 分] Transverse electric modes are excited in an air dielectric parallel-plate waveguide of dimension $a = 5$ cm by setting up its mouth a field distribution having

$$\mathbf{E}=10\left(\sin 20\pi x+0.5\sin 60\pi x\right)\sin 10^{10}\pi t\mathbf{a}_y$$

Determine the propagating mode(s) and obtain the expression for the electric field of the propagating wave.

Some formula for your reference.

$\bar{\gamma} = \sqrt{j\omega\mu(\sigma + j\omega\varepsilon)}$, $\bar{\eta} = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\varepsilon}}$

$\mu_0 = 4\pi \times 10^{-7}$ henrys/m, $\varepsilon_0 = \frac{10^{-9}}{36\pi}$ F/m

Phase constant for a TE wave in a waveguide: $\beta_z = \frac{2\pi}{\lambda}\sqrt{1 - \left(\frac{f_c}{f}\right)^2}$