考試科目 電磁學   所別 通訊工程研究所

註：本次考試 [不可] 參考自己的書籍及筆記 [不可] 查字典 [不可] 使用計算器

(1) Given electric field phasor $\mathbf{E} = 80\pi e^{-j\frac{2\pi}{\lambda}\mathbf{a_k} \bullet \mathbf{r}}\mathbf{a_y}$ V/m representing an uniform plane wave in rectangular coordinates $\mathbf{r} = x\mathbf{a_x} + y\mathbf{a_y} + z\mathbf{a_z}$ at frequency $f = 1$ GHz $= 10^9$ Hz that propagates in the direction $\mathbf{a_k} = \frac{4}{5}\mathbf{a_x} - \frac{3}{5}\mathbf{a_z}$ in a homogeneous medium with relative permittivity and permeability e_r and $\mu_r = 1$. The sinusoidal electric and magnetic field are $\mathbf{e}(t) \equiv Re\{\mathbf{E}e^{j2\pi ft}\} = \mathbf{a_y}80\pi\cos(2\pi(ft - 4x + 3z))$ V/m and $\mathbf{h}(t) = \frac{1}{80\pi}Re\{\mathbf{a_k}\times\mathbf{E}e^{j2\pi ft}\} = (H_x\mathbf{a_x} + H_z\mathbf{a_z})\cos(2\pi(ft - 4x + 3z))$ A/m. Answer in numerical value (a) the wavelength in the direction of propagation $\lambda = ?$ m , (b) the relative permittivity of the medium $e_r = ?$ (c) the magnitude of x-component magnetic field phasor $H_x = ?$ A/m. (d) the phase velocity in the medium along the z-axis $v_z = ?$ m/s.

(2). For the circuit shown in the figure, a voltage source with r.m.s. $V_s = 6$ volt and internal impedance $Z_s = 3+j4$ ohm is connected through a loss less quarter wave transmission line with $L = \lambda/4$ and characteristic impedance $Z_o = 5$ ohm to a load impedance Z_2 . The input impedance at input end $11'$ is $Z_1 = 3-j4$ ohm.
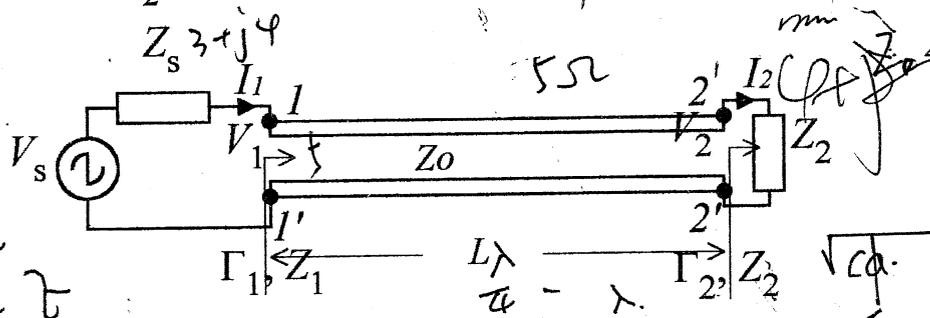
Answer in numerical value (a) the magnitude of reflection at input end $11'$ $|\Gamma_1|$ $= ?$, (b) the r.m.s. magnitude of the voltage at input end $11'$ $|V_1| = ?$ volt, (c) the load impedance at the output end $22'$ $Z_2 = ?$ ohm, and (d) the time average power delivered to the load $P = Re\{V_2 I_2^*\} = ?$ Watt.

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(3) A 10 GHz plane wave travelling in free space has an amplitude of 10 v/m,

(a) If the wave is travelling in the" -z" direction and E-field in x-direction, find the amplitude and direction of the magnectic field intensity.

(b) If the wave is travelling in a direction which makes an angle of $\alpha, \beta,$ and γ with x, y and z axis respectively; and the direction of its associated electric field makes an angle of $\eta, \theta,$ and ζ with x, y and z axis respectively, show that either γ or ζ is 90° when $\alpha + \beta = 180^o$ and $\eta = \theta$

(c) Let $\alpha = 30^o, \beta = 45^o, \gamma = 60^o$ and the associated electric and magnetic fields are denoted in cylindrical coordinate by $\vec{E} = E_\phi \vec{a_\phi}, \vec{H} = H_\rho \vec{a_\rho} + H_z \vec{a_z}$, Find E_ϕ / H_ρ
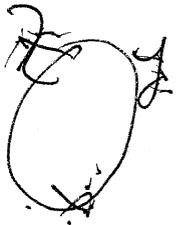
(4) (a) Given $\vec{V_1} \times \vec{B} = 3 \vec{a_x}, \vec{a_x} \times \vec{B} = 4 \vec{a_z}$, find $\vec{B}$

(b) Given $\vec{E} = x \vec{a_x} + y \vec{a_y} + z \vec{a_z}$, find $\nabla(1/|\vec{E}|)$ at point (1,1,1)

(c) Verify Stock's theorem by considering $\vec{A} = x^2 \vec{a_x} + y \vec{a_y}$ and a closed path of your own choice.

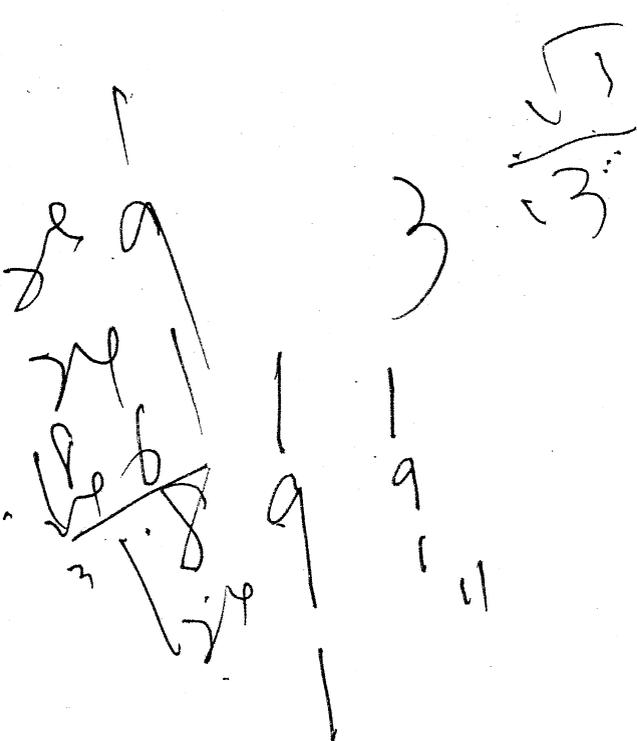(d) Given V=xyz, evaluate $\int (\nabla V) \cdot \vec{dl}$ along any path you selected. The path, however, should start at the point of (1,2,3) and end at (3,8,1).