Quiz-4

Date ..../..../.....

Ques 1 (a) ⇒ $E \rightarrow V/m$ (unit), $H \rightarrow A/m$ (unit)

$$\frac{E}{H} \rightarrow \frac{V}{A} \rightarrow \text{ohm}(\Omega)$$ — (1) Mark

(b) $$\frac{E}{H} = \sqrt{\frac{\mu}{\varepsilon}}$$

$$\varepsilon_c = \varepsilon\left[1 - j\frac{\sigma}{\omega\varepsilon}\right]$$ — upto this (0.5) Mark

$$\frac{E}{H} = \sqrt{\frac{\mu}{\varepsilon(1 - i(\sigma/\omega\varepsilon))}}$$ — if this then (2) Marks.

(c) No [(1) mark only when the last Part (b) is Correct, otherwise 0]

(d) $$\frac{E}{H} = \sqrt{\frac{\mu}{-ib}} = \sqrt{\frac{\mu}{b}}\,(i)^{-1/2}$$

↑ upto this (1) mark

→ upto this 1.5 Marks.

$$\angle E/H = \pi/4$$ — (3) Marks

Q2 ⇒ $\varepsilon = \varepsilon_0$ in free space.

Displacement current $\varepsilon \frac{d\vec{E}}{dt} = \varepsilon_0\, 4\hat{x}\, i(5\times10^6) \exp[i(5\times10^6 t - kz)]$

Displacement current $= \varepsilon_0 4\hat{x}\, i(5\times10^6)\exp[i(5\times10^6 t - kz)]$

$= i\,20\times10^6\,\varepsilon_0\,\hat{x}\exp[i(5\times10^6 t - kz)]$

— (2) Marks Spiral

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Q3:⇒ Actual electric field is ⇒

$$E_{x_1}(z,t) = E_{x_1}(z)\, e^{i\omega t}$$

$$= A e^{i(\omega t - k_1 z)} + C e^{i(\omega t + k_1 z)}$$

According to hint, one can omit the time dependence part and E_{x_1} will be ⇒

$$E_{x_1} = A e^{-i k_1 z} + C e^{i k_1 z}$$

Now, let us try to write it in a form: ⇒

$$E_{x_1} = r e^{i\theta}$$

Now equating both

$$A e^{-ik_1 z} + C e^{ik_1 z} = r e^{-i\theta}$$

$$(A+C)\cos(k_1 z) - i(A-C)\sin(k_1 z) = r\cos\theta - i r\sin\theta$$

Equate real and imaginary parts: ⇒

$$r\cos\theta = (A+C)\cos(k_1 z) \quad \text{— (3)}$$

$$r\sin\theta = (A-C)\sin(k_1 z) \quad \text{— (4)}$$

— (1) marks upto this point.

$$\therefore \tan\theta = \left(\frac{A-C}{A+C}\right)\tan(k_1 z)$$

$$\theta = \tan^{-1}\left[\left(\frac{A-C}{A+C}\right)\tan(k_1 z)\right] \quad \text{— (5)}$$

— (2) Marks

Spiral

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and $r = \sqrt{(A+C)^2 \cos^2(K_1 z) + (A-C)^2 \sin^2(K_1 z)}$

$= \sqrt{A^2 + C^2 + 2AC\cos^2(K_1 z) - 2AC\sin^2(K_1 z)}$

$= \sqrt{A^2 + C^2 + 2AC\cos(2K_1 z)}$ — 3 Marks

$\therefore E_{x_1} = r e^{-i\theta}$

$= \sqrt{A^2 + C^2 + 2AC\cos(2K_1 z)}\, e^{-i\tan^{-1}\left\{\left(\frac{A-C}{A+C}\right)\tan(K_1 z)\right\}}$

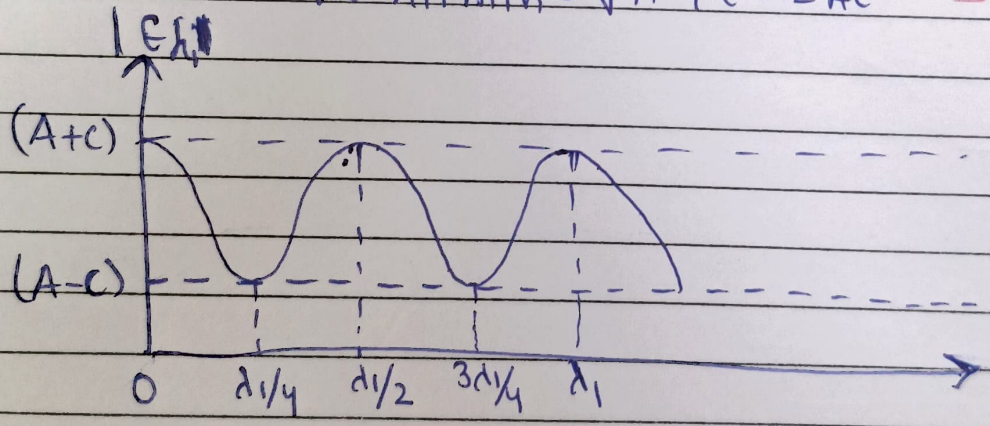
$|E_{x_1}| = \sqrt{A^2 + C^2 + 2AC\cos(2K_1 z)}$

— 4 Marks

Part 2 ⇒ $|E_{x_1}|_{max} = \sqrt{A^2 + C^2 + 2AC}$

$|E_{x_1}|_{min} = \sqrt{A^2 + C^2 - 2AC}$

} 1 marks



1 mark