SCS139 HW4

Tuesday, February 19, 2013 2:06 PM

Q1 $i(t) = 8\cos(500\pi t - 25^\circ)\ A$

(a) $I_m = 8\ A$

(b) $\omega = 500\pi\ rad/s$

(c) $\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi} = \frac{500\pi}{2\pi} = 250\ Hz$

(d) $t = 2\ ms = 2\times10^{-3}\ s$

$\Rightarrow i(t) = 8\cos(500\pi\times 2\times10^{-3} - 25^\circ) = 8\cos(\pi - 25^\circ)$

$= 8\cos(180^\circ - 25^\circ) = 8\cos(155^\circ) \approx -7.25\ A$

Q2

(a) $v(t) = 21\cos(4t + (-15^\circ))\ V$

(b) $i(t) = -8\sin(10t + 70^\circ)\ mA = 8\cos(10t + 70^\circ - 90^\circ + 180^\circ)$

$= 8\cos(10t + 160^\circ)\ mA$

$(= (8\ mA)\cos(10t + 160^\circ))$

sin → cos, −cos → cos

(c) $v(t) = 120\sin(10t - 50^\circ)\ V = 120\cos(10t - 50^\circ - 90^\circ)$

sin → cos

$= 120\cos(10t + (-140^\circ))\ V$

(d) $i(t) = -60\cos(30t + 10^\circ)\ mA = 60\cos(30t + 10^\circ - 180^\circ)\ mA$

$= 60\cos(30t + (-170^\circ))\ mA$

−cos → cos

Q3 We have two wavelengths λ_1 and λ_2 around 632.8 nm

We know that $\underbrace{\lambda_2 - \lambda_1}_{\Delta\lambda} = 0.01\ nm$

From $c = f\lambda$, we have $f = \frac{c}{\lambda}$ and

$$\frac{df}{d\lambda} = -\frac{c}{\lambda^2}.$$

Therefore, when $\Delta\lambda$ is small,

$$|\Delta f| \approx \frac{c}{\lambda^2}\Delta\lambda \approx 7.5\ \text{GHz}$$

Q4 $E_m = 5\ V/m \Rightarrow B_m = \frac{E_m}{c} \approx 1.67 \times 10^{-8}\ T$

$c = \frac{E_m}{B_m}$