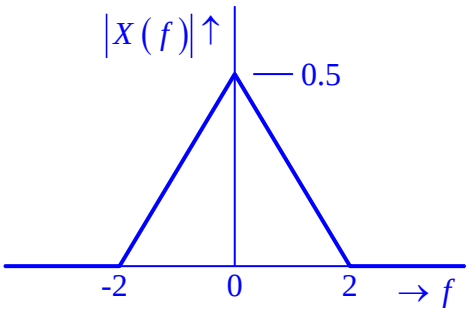
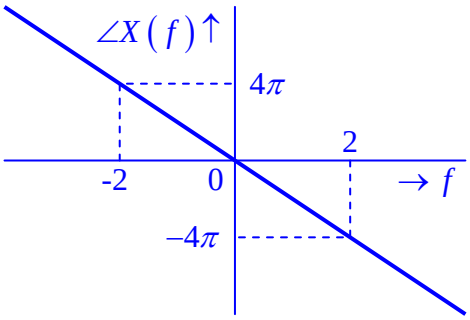
ANSWER KEY

Q.1 (a) $X(f) = \frac{1}{2}\text{tri}\left(\frac{f}{2}\right)e^{-j2\pi f}$

(b) Magnitude Spectrum: $|X(f)| = \frac{1}{2}\text{tri}\left(\frac{f}{2}\right)$



Phase Spectrum: $\angle X(f) = -2\pi f$



(c) $Y(f) = \frac{1}{4}\left[\text{tri}\left(\frac{f-100}{2}\right)e^{-j0.5\pi} + \text{tri}\left(\frac{f+100}{2}\right)e^{j0.5\pi}\right]e^{-j2\pi f}$

1^{st}-null bandwidth of $y(t) = 4$ Hz

Q.2 (a) Fundamental frequency $= \pi\sqrt{2}$ rad/s
DC value $= 0$

(b) $\{c_{\pm 1} = 2 \mp j, \quad c_{-2} = -1 + j, \quad c_{\pm 3} = -3, \quad \text{and} \quad c_k = 0 \text{ for } k \neq \pm 1,\ 2 \text{ and } \pm 3$

(c) $P = 30$ W

Q.3 (a) $E_x(f) = \frac{1}{\pi^2 f^2}\left[1 - \text{sinc}(2f)\right]^2$

(b) $X(0) = \int_{-\infty}^{\infty} x(t)\,dt = \underbrace{\text{AREA UNDER } x(t) = 0}_{\substack{\text{by inspection of} \\ \text{Figure Q3(a)}}}$

(c) $y(t) = \sum_n x(t - 2n)$

(d) $P_y(f) = \sum_k \frac{1}{4}|X(f)|^2 \delta\left(f - \frac{k}{2}\right)$

Q.4 (a) $A=3,\ B=4,\ C=8,\ \alpha=2,\ \beta=4$ and $\gamma=2$

(b) $Q(f)=\left[24\text{sinc}(8f)+4\text{sinc}^2(2f)\right]e^{-j8\pi f}$

(c) $E=101\frac{1}{3}$ J

(d)