ANSWER KEY

Q.1 (a) $X(f) = 4\,\text{sinc}(f)\cos(\pi f)$

     (b)   8 J

     (c)   0.5 Hz

Q.2 (a) $X(f) = \text{sinc}(2f + 0.5) + \text{sinc}(2f - 0.5)$

     (b)   1 J

     (c)   Power signal with average power 4 W

Q.3 (a)   Zero: $s = 1$ Poles: $s_1 = -2$ and $s_2 = -0.2$
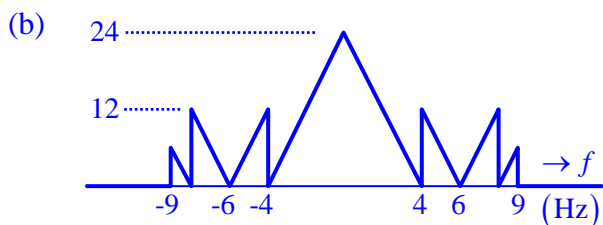
     (b)   Yes (Why?)

     (c)   No (Why?)

     (d) $\lim\limits_{s \to \infty} \tilde{H}(s) \to -\dfrac{4}{s}$, which is an inverting integrator of gain 4.

            High-frequency asymptotic slope of Bode magnitude plot $= -20$ dB/decade.

            High-frequency asymptotic value of Bode phase plot $= 90°$.

Q.4 (a)   12 Hz

     (b)

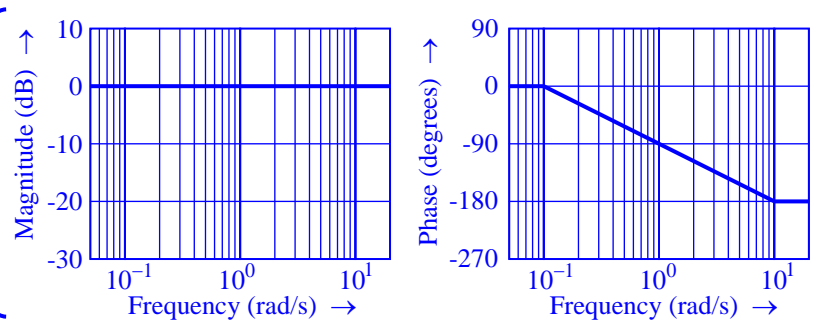   Not identical to $X(f)$.

     (c)   15 Hz

Q.5 (a) $\tilde{H}(s) = \dfrac{2s}{(s+1)^2}$

(b) $y_{ss}(t) = 5\sin(t + 30°)$

(c) $\tilde{H}_1(s) = \dfrac{2s}{1 - s^2}$

(d)

$\tilde{H}_2(s)$ stabilizes $\tilde{H}_1(s)$ by reflecting its unstable pole from the right-half to the left-half s-plane.

Q.6 (a) $S_d(f) = 2\text{rect}(f + 50) + 2\text{rect}(f - 50) + \text{tri}\left(\dfrac{f + 100}{4}\right) + \text{tri}\left(\dfrac{f - 100}{4}\right)$

(b) $B_1 = 0.5$ Hz, $B_2 = 4$ Hz, $f_1 = 50$ Hz and $f_2 = 100$ Hz

(c)