Solution of EECS 315 Test 2 F13

1. (a) Find the numerical signal power of a continuous-time periodic signal, one fundamental period of which is described by $x(t) = \begin{cases} 3 & , \ 2 < t \le 5 \\ -4 & , \ 5 < t \le 10 \end{cases}$.

$$P_x = \frac{1}{T}\int_T \left|x^2(t)\right| dt = \frac{1}{8}\int_2^{10} \left|x^2(t)\right| dt = \frac{1}{8}\left[\int_2^5 9\,dt + \int_5^{10} 16\,dt\right] = \frac{27+80}{8} = 13.375$$

(b) If $y(t) = -8\,x(t/2)$, find the average signal power of $y(t)$.

The time scaling has no effect on the average signal power. The amplitude scaling by a factor of -8 multiplies the average signal power by $(-8)^2 = 64$. So $P_y = 13.375 \times 64 = 856$.

2. Find the numerical fundamental period of the following sums of sinusoids. If the sum is not periodic just write in "infinity" or "∞ ".

(a) $x(t) = 9\cos(32\pi t) - 12\sin(38\pi t)$

Fundamental frequencies are 16 and 19 and overall fundamental frequency is 1, therefore the overall fundamental period is 1.

(b) $x(t) = 4\cos(540\pi t) - 7\cos(360\pi t)$

Fundamental frequencies are 270 and 180 and overall fundamental frequency is 90, therefore the overall fundamental period is 1/90.

(c) $x(t) = 9\cos(\pi t/10) - 3\cos(2\pi t/25)$

Fundamental periods are 20 and 25 and overall fundamental period is 100.

(d) $x(t) = 11\cos(\pi t/8) - 5\cos(2\pi t/12) + 3.3\sin(t/20)$

Fundamental periods are 16, 12 and 40π and overall fundamental period is infinite. This signal is not periodic.

Solution of EECS 315 Test 2 F13

1. (a) Find the numerical signal power of a continuous-time periodic signal, one fundamental period of which is described by $\mathrm{x}(t) = \begin{cases} 2 & , 2 < t \leq 5 \\ -5 & , 5 < t \leq 10 \end{cases}$.

$$P_{\mathrm{x}} = \frac{1}{T}\int_T |\mathrm{x}^2(t)|\,dt = \frac{1}{8}\int_2^{10} |\mathrm{x}^2(t)|\,dt = \frac{1}{8}\left[\int_2^5 4\,dt + \int_5^{10} 25\,dt\right] = \frac{12+125}{8} = 17.125$$

(b) If $\mathrm{y}(t) = -4\,\mathrm{x}(t/2)$, find the average signal power of $\mathrm{y}(t)$.

The time scaling has no effect on the average signal power. The amplitude scaling by a factor of -4 multiplies the average signal power by $(-4)^2 = 16$. So $P_{\mathrm{y}} = 17.125 \times 16 = 274$.

2. Find the numerical fundamental period of the following sums of sinusoids. If the sum is not periodic just write in "infinity" or "∞".

(a) $\mathrm{x}(t) = 9\cos(32\pi t) - 12\sin(36\pi t)$

Fundamental frequencies are 16 and 18 and overall fundamental frequency is 2, therefore the overall fundamental period is 1/2.

(b) $\mathrm{x}(t) = 4\cos(270\pi t) - 7\cos(180\pi t)$

Fundamental frequencies are 135 and 90 and overall fundamental frequency is 45, therefore the overall fundamental period is 1/45.

(c) $\mathrm{x}(t) = 11\cos(\pi t/8) - 5\cos(2\pi t/12) + 3.3\sin(t/20)$

Fundamental periods are 16, 12 and 40π and overall fundamental period is infinite. This signal is not periodic.

(d) $\mathrm{x}(t) = 9\cos(\pi t/10) - 3\cos(2\pi t/30)$

Fundamental periods are 20 and 30 and overall fundamental period is 60.

Solution of EECS 315 Test 2 F13

1. (a) Find the numerical signal power of a continuous-time periodic signal, one fundamental period of which is described by $x(t) = \begin{cases} 7 & , \ 2 < t \le 5 \\ -3 & , \ 5 < t \le 10 \end{cases}$.

$$P_x = \frac{1}{T}\int_T \left|x^2(t)\right| dt = \frac{1}{8}\int_2^{10} \left|x^2(t)\right| dt = \frac{1}{8}\left[\int_2^5 49\,dt + \int_5^{10} 9\,dt\right] = \frac{147+45}{8} = 24$$

(b) If $y(t) = -9\,x(t/2)$, find the average signal power of $y(t)$.

The time scaling has no effect on the average signal power. The amplitude scaling by a factor of -9 multiplies the average signal power by $(-9)^2 = 81$. So $P_y = 24 \times 81 = 1944$.

2. Find the numerical fundamental period of the following sums of sinusoids. If the sum is not periodic just write in "infinity" or "∞ ".

(a) $x(t) = 9\cos(32\pi t) - 12\sin(24\pi t)$

Fundamental frequencies are 16 and 12 and overall fundamental frequency is 4, therefore the overall fundamental period is 1/4.

(b) $x(t) = 11\cos(\pi t/8) - 5\cos(2\pi t/12) + 3.3\sin(t/20)$

Fundamental periods are 16, 12 and 40π and overall fundamental period is infinite. This signal is not periodic.

(c) $x(t) = 9\cos(\pi t/20) - 3\cos(2\pi t/50)$

Fundamental periods are 40 and 50 and overall fundamental period is 200.

(d) $x(t) = 4\cos(90\pi t) - 7\cos(80\pi t)$

Fundamental frequencies are 45 and 40 and overall fundamental frequency is 5, therefore the overall fundamental period is 1/5.