# Solution of ECE 315 Test 1 F07

1. A signal $\mathrm{x}(t)$ is described by $\mathrm{x}(t) = \begin{cases} -5t & , \ 0 \le t < 3 \\ 0 & , \ \text{otherwise} \end{cases}$. Find the numerical value of its signal energy.

$E_x =$ ______________________

$$E_x = \int_{-\infty}^{\infty} |\mathrm{x}(t)|^2 \, dt = \int_0^3 |-5t|^2 \, dt = 25 \int_0^3 t^2 dt = 25\left[t^3/3\right]_0^3 = 25(9) = 225$$

2. A periodic signal $\mathrm{x}(t)$ is described over one period by $\mathrm{x}(t) = \begin{cases} 3 & , \ 0 \le t < 2 \\ -1 & , \ 2 \le t < 5 \end{cases}$.

(a) Find the numerical value of its average signal power $P_x$. $P_x =$ ______________

$$P_x = \frac{1}{T}\int_T |\mathrm{x}(t)|^2 \, dt = \frac{1}{5}\int_0^5 |\mathrm{x}(t)|^2 \, dt = \frac{1}{5}\left[\int_0^2 |3|^2 \, dt + \int_2^5 |-1|^2 \, dt\right]$$

$$P_x = \frac{1}{5}\left[9\int_0^2 dt + \int_2^5 dt\right] = \frac{1}{5}(9 \times 2 + 5 - 2) = 21/5 = 4.2$$

(b) If $\mathrm{y}(t) = \mathrm{x}(3t)$ what is the numerical average signal power of $\mathrm{y}(t)$, $P_y$?

$P_y =$ ______________________

The signal power does not change when a periodic signal is compressed or expanded in time. So the answer is the same, 4.2.

(c) If $\mathrm{z}(t) = 3\mathrm{x}(t-2)$ what is the numerical average signal power of $\mathrm{z}(t)$, $P_z$?

$P_z =$ ______________________

Every point on the signal is now 3 times greater in amplitude. The shift does not affect the average signal power. Therefore the average signal power is $3^2$ times what it was before or $9 \times 4.2 = 37.8$.

# Solution of ECE 315 Test 1 F07

1. A signal $\mathrm{x}(t)$ is described by $\mathrm{x}(t)=\begin{cases}-2t & , \ 0\le t<4 \\ 0 & , \ \text{otherwise}\end{cases}$. Find the numerical value of its signal energy.

$E_x =$ ______________________

$$E_x=\int_{-\infty}^{\infty}\left|\mathrm{x}(t)\right|^2 dt=\int_0^4\left|-2t\right|^2 dt=4\int_0^4 t^2 dt=4\left[t^3/3\right]_0^4=256/3=85.333$$

2. A periodic signal $\mathrm{x}(t)$ is described over one period by $\mathrm{x}(t)=\begin{cases}2 & , \ 0\le t<5 \\ -3 & , \ 5\le t<9\end{cases}$.

(a) Find the numerical value of its average signal power $P_x$. $P_x =$ ________________

$$P_x=\frac{1}{T}\int_T\left|\mathrm{x}(t)\right|^2 dt=\frac{1}{9}\int_0^9\left|\mathrm{x}(t)\right|^2 dt=\frac{1}{9}\left[\int_0^5\left|2\right|^2 dt+\int_5^9\left|-3\right|^2 dt\right]$$

$$P_x=\frac{1}{9}\left[4\int_0^5 dt+9\int_5^9 dt\right]=\frac{1}{9}\left(4\times5+9\times(9-5)\right)=56/9=6.222$$

(b) If $\mathrm{y}(t)=\mathrm{x}(3t)$ what is the numerical average signal power of $\mathrm{y}(t)$, $P_y$?

$P_y =$ ______________________

The signal power does not change when a periodic signal is compressed or expanded in time. So the answer is the same, 6.222.

(c) If $\mathrm{z}(t)=2\,\mathrm{x}(t-2)$ what is the numerical average signal power of $\mathrm{z}(t)$, $P_z$?

$P_z =$ ______________________

Every point on the signal is now 2 times greater in amplitude. The shift does not affect the average signal power. Therefore the average signal power is $2^2$ times what it was before or $4\times6.222=24.889$.

# Solution of ECE 315 Test 1 F07

1. A signal $\mathrm{x}(t)$ is described by $\mathrm{x}(t)=\begin{cases}-4t & , 0\le t<10 \\ 0 & , \text{otherwise}\end{cases}$. Find the numerical value of its signal energy.

$E_x =$ ______________________

$$E_x=\int_{-\infty}^{\infty}\left|\mathrm{x}(t)\right|^2 dt=\int_0^{10}\left|-4t\right|^2 dt=16\int_0^{10}t^2 dt=16\left[t^3/3\right]_0^{10}=16000/3=5333.3$$

2. A periodic signal $\mathrm{x}(t)$ is described over one period by $\mathrm{x}(t)=\begin{cases}7 & , 0\le t<1 \\ -2 & , 1\le t<6\end{cases}$.

(a) Find the numerical value of its average signal power $P_x$. $P_x =$ ________________

$$P_x=\frac{1}{T}\int_T\left|\mathrm{x}(t)\right|^2 dt=\frac{1}{6}\int_0^{6}\left|\mathrm{x}(t)\right|^2 dt=\frac{1}{6}\left[\int_0^1\left|7\right|^2 dt+\int_1^6\left|-2\right|^2 dt\right]$$

$$P_x=\frac{1}{6}\left[49\int_0^1 dt+4\int_1^6 dt\right]=\frac{1}{6}\left(49+4\times\left(6-1\right)\right)=69/6=11.5$$

(b) If $\mathrm{y}(t)=\mathrm{x}(3t)$ what is the numerical average signal power of $\mathrm{y}(t)$, $P_y$?

$P_y =$ ______________________

The signal power does not change when a periodic signal is compressed or expanded in time. So the answer is the same, 11.5.

(c) If $\mathrm{z}(t)=4\,\mathrm{x}(t-2)$ what is the numerical average signal power of $\mathrm{z}(t)$, $P_z$?

$P_z =$ ______________________

Every point on the signal is now 4 times greater in amplitude. The shift does not affect the average signal power. Therefore the average signal power is $4^2$ times what it was before or $16\times 11.5=184$.