Solution to ECE Test #2 S08 #1

As diagrammed in the figure below, a signal $\mathrm{x}(t) = 12\sin(4000\pi t) + 8\cos(5000\pi t)$ multiplies a carrier $\cos(100000\pi t)$ and the product $\mathrm{y}_{DSBSC}(t)$ is filtered by an ideal unity-gain bandpass filter which allows only the upper sideband to pass through to form $\mathrm{y}(t)$. (The signal power of any sinusoid is one-half of the square of its amplitude. It is also the sum of the squares of the magnitudes of the impulse strengths in its CTFT. The signal power of a sum of sinusoids is the sum of their individual signal powers <u>if they are of different frequencies</u>.)

(a) Find the numerical signal power of $\mathrm{x}(t)$. $P_x =$ _________

$$P_x = 12^2/2 + 8^2/2 = 104$$

(b) Find the numerical signal power of $\mathrm{y}_{DSBSC}(t)$. $P_{DSBSC} =$ _____

$$\mathrm{X}(f) = (j12/2)\left[\delta(f+2000) - \delta(f-2000)\right] + (8/2)\left[\delta(f-2500) + \delta(f+2500)\right]$$

$$\mathrm{Y}_{DSBSC}(f) = (1/2)\left[\delta(f-50000) + \delta(f+50000)\right] * \left\{ \begin{array}{l} (j12/2)\left[\delta(f+2000) - \delta(f-2000)\right] \\ +(8/2)\left[\delta(f-2500) + \delta(f+2500)\right] \end{array} \right\}$$

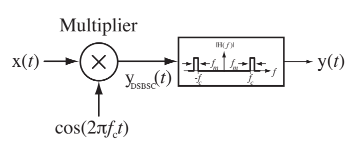
$$\mathrm{Y}_{DSBSC}(f) = \left\{ \begin{array}{l} j3\left[\delta(f-48000) + \delta(f+52000) - \delta(f-52000) - \delta(f+48000)\right] \\ +2\left[\delta(f-52500) + \delta(f+47500) + \delta(f-47500) + \delta(f+52500)\right] \end{array} \right\}$$

$$P_{DSBSC} = 3^2 + 3^2 + 3^2 + 3^2 + 2^2 + 2^2 + 2^2 + 2^2 = 52$$

(c) Find the numerical signal power of $\mathrm{y}(t)$. $P_{\mathrm{y}} =$ ___________

$$\mathrm{Y}(f) = j3\left[\delta(f+52000) - \delta(f-52000)\right] + 2\left[\delta(f-52500) + \delta(f+52500)\right]$$

$$P_{\mathrm{y}} = 3^2 + 3^2 + 2^2 + 2^2 = 26$$



Solution to ECE Test #2 S08 #1

As diagrammed in the figure below, a signal $x(t) = 10\sin(4000\pi t) + 20\cos(5000\pi t)$ multiplies a carrier $\cos(100000\pi t)$ and the product $y_{DSBSC}(t)$ is filtered by an ideal unity-gain bandpass filter which allows only the upper sideband to pass through to form $y(t)$. (The signal power of any sinusoid is one-half of the square of its amplitude. It is also the sum of the squares of the magnitudes of the impulse strengths in its CTFT. The signal power of a sum of sinusoids is the sum of their individual signal powers <u>if they are of different frequencies</u>.)

(a) Find the numerical signal power of $x(t)$. $P_x =$ __________

$$P_x = 10^2/2 + 20^2/2 = 250$$

(b) Find the numerical signal power of $y_{DSBSC}(t)$. $P_{DSBSC} =$ ______

$$X(f) = (j10/2)[\delta(f+2000) - \delta(f-2000)] + (20/2)[\delta(f-2500) + \delta(f+2500)]$$

$$Y_{DSBSC}(f) = (1/2)[\delta(f-50000) + \delta(f+50000)] * \begin{Bmatrix} (j10/2)[\delta(f+2000) - \delta(f-2000)] \\ +(20/2)[\delta(f-2500) + \delta(f+2500)] \end{Bmatrix}$$

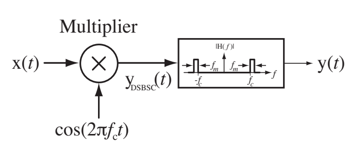
$$Y_{DSBSC}(f) = \begin{Bmatrix} j(5/2)[\delta(f-48000) + \delta(f+52000) - \delta(f-52000) - \delta(f+48000)] \\ +5[\delta(f-52500) + \delta(f+47500) + \delta(f-47500) + \delta(f+52500)] \end{Bmatrix}$$

$$P_{DSBSC} = (5/2)^2 + (5/2)^2 + (5/2)^2 + (5/2)^2 + 5^2 + 5^2 + 5^2 + 5^2 = 125$$

(c) Find the numerical signal power of $y(t)$. $P_y =$ ___________

$$Y(f) = j(5/2)[\delta(f+52000) - \delta(f-52000)] + 5[\delta(f-52500) + \delta(f+52500)]$$

$$P_y = (5/2)^2 + (5/2)^2 + 5^2 + 5^2 = 62.5$$



Solution to ECE Test #2 S08 #1

As diagrammed in the figure below, a signal $x(t) = 4\sin(4000\pi t) + 5\cos(5000\pi t)$ multiplies a carrier $\cos(100000\pi t)$ and the product $y_{DSBSC}(t)$ is filtered by an ideal unity-gain bandpass filter which allows only the upper sideband to pass through to form $y(t)$. (The signal power of any sinusoid is one-half of the square of its amplitude. It is also the sum of the squares of the magnitudes of the impulse strengths in its CTFT. The signal power of a sum of sinusoids is the sum of their individual signal powers <u>if they are of different frequencies</u>.)

(a) Find the numerical signal power of $x(t)$. $P_x =$ __________

$$P_x = 4^2/2 + 5^2/2 = 20.5$$

(b) Find the numerical signal power of $y_{DSBSC}(t)$. $P_{DSBSC} =$ ______

$$X(f) = (j4/2)[\delta(f+2000) - \delta(f-2000)] + (5/2)[\delta(f-2500) + \delta(f+2500)]$$

$$Y_{DSBSC}(f) = (1/2)[\delta(f-50000) + \delta(f+50000)] * \begin{Bmatrix} (j4/2)[\delta(f+2000) - \delta(f-2000)] \\ +(5/2)[\delta(f-2500) + \delta(f+2500)] \end{Bmatrix}$$

$$Y_{DSBSC}(f) = \begin{Bmatrix} j[\delta(f-48000) + \delta(f+52000) - \delta(f-52000) - \delta(f+48000)] \\ +(5/4)[\delta(f-52500) + \delta(f+47500) + \delta(f-47500) + \delta(f+52500)] \end{Bmatrix}$$

$$P_{DSBSC} = 1^2 + 1^2 + 1^2 + 1^2 + (5/4)^2 + (5/4)^2 + (5/4)^2 + (5/4)^2 = 10.25$$

(c) Find the numerical signal power of $y(t)$. $P_y =$ ___________

$$Y(f) = j[\delta(f+52000) - \delta(f-52000)] + (5/4)[\delta(f-52500) + \delta(f+52500)]$$

$$P_y = 1^2 + 1^2 + (5/4)^2 + (5/4)^2 = 5.125$$