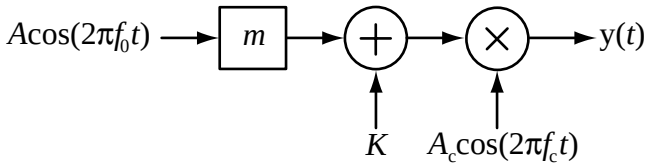
Solution of ECE 315 Test 13 F05

In the system below let $f_0 = 10$, $m = 1$, $A_c = 1$ and $f_c = 1000$.



(a) (8 pts) If $A = 1$ and $K = 1$ what is the numerical signal power of $y(t)$?

Signal Power = 3/4

(The power of a sum of sinusoids of different frequencies is the sum of their powers.)

(The signal power of any sinusoid is half the square of its amplitude.)

$$y(t) = \left[\cos(20\pi t) + 1\right]\cos(2000\pi t) = \cos(20\pi t)\cos(2000\pi t) + \cos(2000\pi t)$$

$$y(t) = (1/2)\left[\cos(1980\pi t) + \cos(2020\pi t)\right] + \cos(2000\pi t)$$

$$y(t) = \underset{P=1/8}{(1/2)\cos(1980\pi t)} + \underset{P=1/8}{(1/2)\cos(2020\pi t)} + \underset{P=1/2}{\cos(2000\pi t)}$$

Since all three sinusoidal frequencies are different, the power of the sum is the sum of the powers which is 3/4 in this case.

(b) (6 pts) If $A = 1$ and the signal power of $y(t)$ is the same as the signal power in $A\cos(2\pi f_0 t)$, what is the numerical value of K? K = 0.707

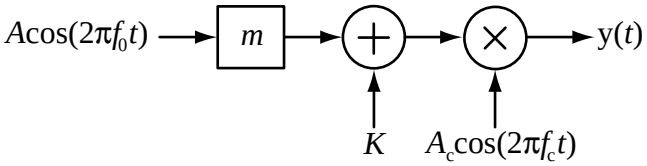
The signal power of $A\cos(2\pi f_0 t)$ with A = 1 is 1/2.

$$y(t) = \left[\cos(20\pi t) + K\right]\cos(2000\pi t) = \underset{P=1/4\ \text{(part (a))}}{\cos(20\pi t)\cos(2000\pi t)} + \underset{P=1/4}{K\cos(2000\pi t)}$$

$$\underset{P=1/4}{K\cos(2000\pi t)} \Rightarrow K^2/2 = 1/4 \Rightarrow K = 1/\sqrt{2} = 0.707$$

Solution of ECE 315 Test 13 F05

In the system below let $f_0 = 10$, $m = 1$, $A_c = 1$ and $f_c = 1000$.



(a) (8 pts) If $A = 2$ and $K = 1$ what is the numerical signal power of $y(t)$?

Signal Power = 3/2

(The power of a sum of sinusoids of different frequencies is the sum of their powers.)

(The signal power of any sinusoid is half the square of its amplitude.)

$$y(t) = \left[2\cos(20\pi t) + 1\right]\cos(2000\pi t) = 2\cos(20\pi t)\cos(2000\pi t) + \cos(2000\pi t)$$

$$y(t) = \cos(1980\pi t) + \cos(2020\pi t) + \cos(2000\pi t)$$

$$y(t) = \underset{P=1/2}{\cos(1980\pi t)} + \underset{P=1/2}{\cos(2020\pi t)} + \underset{P=1/2}{\cos(2000\pi t)}$$

Since all three sinusoidal frequencies are different, the power of the sum is the sum of the powers which is 3/2 in this case.

(b) (6 pts) If $A = 1$ and the signal power of $y(t)$ is the same as the signal power in $A\cos(2\pi f_0 t)$, what is the numerical value of *K*? K = 0.707

The signal power of $A\cos(2\pi f_0 t)$ with A = 1 is 1/2.

$$y(t) = \left[\cos(20\pi t) + K\right]\cos(2000\pi t) = \underset{P=1/4\ \text{(part (a))}}{\cos(20\pi t)\cos(2000\pi t)} + \underset{P=1/4}{K\cos(2000\pi t)}$$

$$\underset{P=1/4}{K\cos(2000\pi t)} \Rightarrow K^2/2 = 1/4 \Rightarrow K = 1/\sqrt{2} = 0.707$$