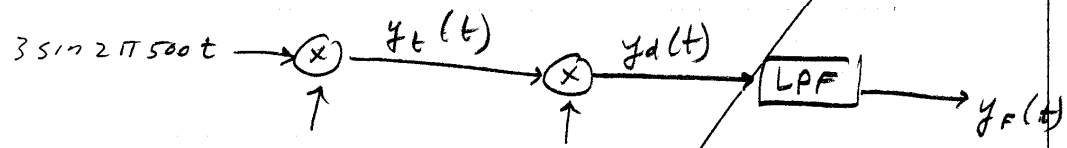
① Text 12-44

12-44 Not assigned



note: $\sin A \cos B = \frac{1}{2}\sin(A-B) + \frac{1}{2}\sin(A+B)$

$\sin(-A) = -\sin(A)$

$\cos(-A) = \cos(A)$

(a) $y_t(t) = (3\sin 2\pi 500t)(\cos 2\pi 5000t)$

$= 3\left[\frac{1}{2}\sin 2\pi(-4500t) + \frac{1}{2}\sin 2\pi 5500t\right]$

$= -\frac{3}{2}\sin 2\pi 4500t + \frac{3}{2}\sin 2\pi 5500t$

$P_{avg} = \frac{(3/2)^2}{2}$ $\quad$ $P_{avg} = \frac{(3/2)^2}{2}$

$P_{tot} = \frac{9}{8} + \frac{9}{8} = \frac{18}{8} = \frac{9}{4}\,W = \boxed{2.25\,W}$

(b) $y_d(t) = \left[-\frac{3}{2}\sin 2\pi 4500t + \frac{3}{2}\sin 2\pi 5500t\right]\cos 2\pi 5000t$

$= -\frac{3}{2}\sin 2\pi 4500t \cos 2\pi 5000t + \frac{3}{2}\sin 2\pi 5500t \cos 2\pi 5000t$

$= \frac{3}{4}\sin 2\pi 500t + \frac{3}{4}\sin 2\pi 9500t + \frac{3}{4}\sin 2\pi 500t + \frac{3}{4}\sin 2\pi 10500t$

$= \frac{6}{4}\sin 2\pi 500t + \frac{3}{4}\sin 2\pi 9500t + \frac{3}{4}\sin 2\pi 10{,}500t$

$P_{avg} = \frac{(6/4)^2}{2} + \frac{(3/4)^2}{2} + \frac{(3/4)^2}{2} = 9/8 + 9/16 = 27/16 = \boxed{1.6875\,W}$

4 9/16

12-44 not assigned

(c) if the cutoff freq is 1kHz, only the 500 Hz sine wave passes through the filter

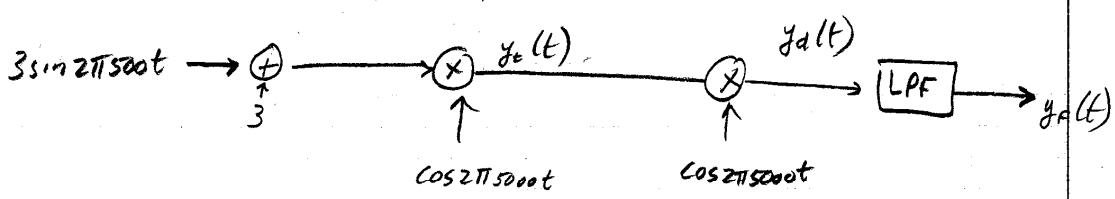
$$y_F(t) = \frac{3}{2} \sin 2\pi 500t$$

$$P_{avg} = \frac{(3/2)^2}{2} = 9/8 = \boxed{1.125\,W}$$

(d) if the cutoff freq is 100 Hz, none of the signal passes through the filter

$$P_{avg} = \boxed{0\,W}$$

(2) Text, 12-45



(a) $y_t(t) = \left[3 + 3(\sin 2\pi 500t)\right] \cos 2\pi 5000t$

$$= 3\cos 2\pi 5000t + 3 \sin 2\pi 500t \cos 2\pi 5000t$$

$$= 3\cos 2\pi 5000t - \frac{3}{2}\sin 2\pi 4500t + \frac{3}{2}\sin 2\pi 5500t$$

$$P_{avg} = \frac{3^2}{2} + \frac{(3/2)^2}{2} + \frac{(3/2)^2}{2} = \boxed{6.75\,W}$$

(b) $y_d(t) = \left[3\cos 2\pi 5000t - \frac{3}{2}\sin 2\pi 4500t + \frac{3}{2}\sin 2\pi 5500t\right]\cos 2\pi 5000t$

$= \frac{3}{2}\cos 2\pi 10{,}000t + \frac{3}{2}\cancelto{1}{\cos 2\pi 0t} + \frac{3}{4}\sin 2\pi 500t - \frac{3}{4}\sin 2\pi 9500t + \frac{3}{4}\sin 2\pi 500t$
$+ \frac{3}{4}\sin 2\pi 10{,}500t$

$= \frac{3}{2}\cos 2\pi 10{,}000t + \frac{3}{2} + \frac{3}{2}\sin 2\pi 500t - \frac{3}{4}\sin 2\pi 9500t + \frac{3}{4}\sin 2\pi 10500t$

$P_{avg} = \frac{\left(\frac{3}{2}\right)^2}{2} + \left(\frac{3}{2}\right)^2 + \frac{\left(\frac{3}{2}\right)^2}{2} + \frac{(3/4)^2}{2} + \frac{(3/4)^2}{2} = \boxed{5.0625W}$

(c) if f_{cutoff} is 1kHz, only dc and 500 Hz signal gets through filter

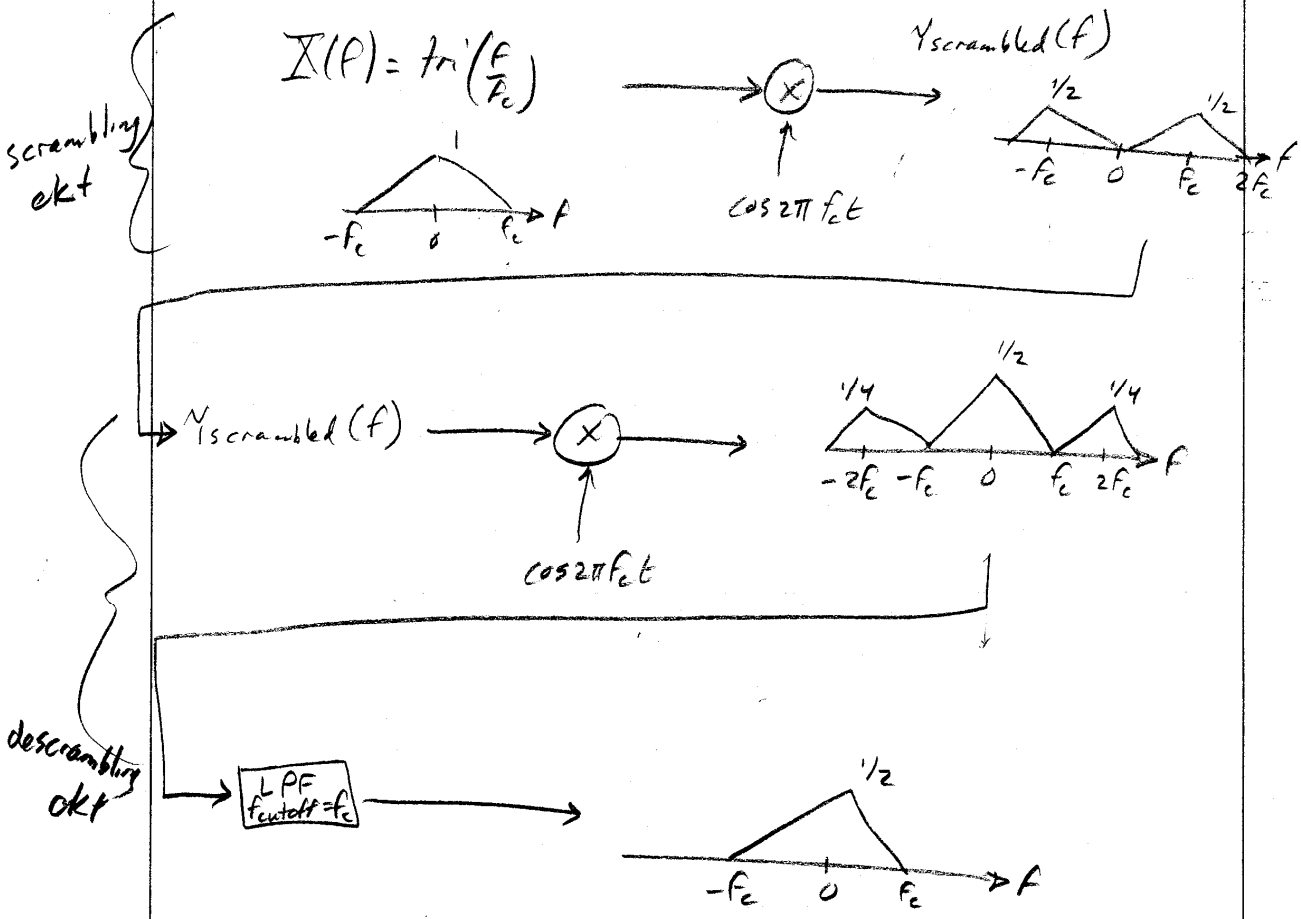
$P_{avg} = \left(\frac{3}{2}\right)^2 + \frac{(3/2)^2}{2} = \boxed{3.375W}$

(d) if f_{cutoff} is 100 Hz, only dc will pass through filter

$P_{avg} = \left(\frac{3}{2}\right)^2 = \boxed{2.25W}$

TOPS. 35500

(3) Text, 12-48


scrambling ckt
$X(f) = tri\left(\frac{f}{f_c}\right)$
1
$-f_c$
0
f_c
f
$\cos 2\pi f_c t$
$Y_{scrambled}(f)$
1/2
1/2
$-f_c$
0
f_c
$2f_c$
f
$Y_{scrambled}(f)$
$\cos 2\pi f_c t$
1/4
1/2
1/4
$-2f_c$
$-f_c$
0
f_c
$2f_c$
f
descrambling ckt
LPF
$f_{cutoff} = f_c$
1/2
$-f_c$
0
f_c
f