Bilješk

41. $x(t) = 1 + \cos(2\pi 1000t + \pi/8)$

$R = 10\Omega$ $\quad P = ?$ $\quad A = 1$

- za 1Ω je istosmjerna $+ \frac{A^2}{2} = 1 + \frac{1}{2} = 1{,}5\ W$

- za 10Ω je 10x manja $\Rightarrow \frac{1{,}5}{10} = \boxed{0{,}15W}$

42. $x(t) = \begin{cases} e^{-\alpha t}, t \geq 0 \\ 0, t < 0 \end{cases}$, $t \in R$, $\alpha > 0$

$\alpha = 30$, $f = 10Hz$, $|X(f)| = ?$

$$X(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi ft}\, dt = \int_0^{\infty} e^{-30t} \cdot e^{-j2\pi \cdot 10t} = \int_0^{\infty} e^{-t(30 + j2\pi \cdot 10)} =$$

$$= \frac{1}{30 + j2\pi \cdot 10} e^{-t(30+j2\pi\cdot 10)} \Big|_0^{\infty} = \frac{-1}{30 + j2\pi \cdot 10}$$

$$|X(f)| = \frac{1}{\sqrt{30^2 + (2\pi \cdot 10)^2}} = \frac{1}{\sqrt{900 + 4\pi^2 \cdot 100}} = \boxed{0{,}01437}$$

43. $\frac{\tau}{T_0 - \tau} = \frac{1}{4} \quad \boxed{5\tau = T_0}$

$P_{UK} = \frac{A^2 \tau}{T_0}$ $\quad P_{ISTOSM} = P_{UK} \cdot \frac{\tau}{T_0}$

$$\frac{P_I}{P_{UK}} = \frac{\tau}{T_0} = \frac{\tau}{5\tau} = 0{,}2 \cdot 100\% = \boxed{20\%}$$

Datum Bilješke

(44.) $f_g = 10 \cdot 10^6 Hz = B$

$S_N = 10^{-10} W/Hz \Rightarrow S_N = \frac{N_0}{2} \quad N_0 = 2 \cdot 10^{-10} W/Hz$

$|H(f)| = 0,2 \qquad S_{x_5} = N = N_0 B = 2 \cdot 10^{-10} \cdot 10^7 = 2 \cdot 10^{-3}$

$S_{y_5} = ? \qquad S_{y_5} = S_{x_5} \cdot |H(f)|^2 = 2 \cdot 10^{-3} \cdot 0,04 = \boxed{0,08 mW}$

$S_y = S_x |H(f)|^2$

(45) $u_m(t) = 0,8 \sin(2\pi 4000t + \frac{\pi}{4})$

$A_1 = 0,8$

$P_1 = \frac{A_1^2}{2} = 0,32W \qquad \frac{P_1}{P_2} = 5dB = 10 \log_{10} X$

$P_2 = \frac{A_2^2}{2} \qquad \frac{P_1}{P_2} = \sqrt{10} \Rightarrow P_2 = \frac{0,32}{\sqrt{10}} = 0,1012W$

$A_2 = \sqrt{2P_2} = 0,45$

$u_{m_2}(t) = A_2 \cdot \sin(2\pi 4000t + \frac{\pi}{4})$

$u_{m_2}(0) = 0,45 \cdot (0 + \frac{\pi}{4}) = \frac{0,45}{\sqrt{2}} = 0,318$ (iz grafa očitamo da je to 101)

(46.) $u_m(t) = \sin(2\pi 1000t + \frac{\pi}{4}) \Rightarrow A = 1$

$f_u = 4000Hz$
$L = 32 \rightarrow$
$u_{max} = 3V \rightarrow \left(\frac{S}{N}\right) = \left(\frac{3S}{u_{max}^2}\right) \cdot L^2$

$\left(\frac{S}{N}\right) = ? \qquad S = \frac{A^2}{2} = \frac{1}{2} \uparrow \qquad \left(\frac{S}{N}\right) = \frac{3 \cdot \frac{1}{2}}{9} \cdot 1024 = 170,67$

$\left(\frac{S}{N}\right) = 10 \log_{10} 170,67 = \boxed{22,32 dB}$

(47.) ??

(48.) $B = 10000Hz \Rightarrow f_u = 2B = 20000Hz$
$L = 256 \Rightarrow r = 8 \quad (L = 2^r)$

$\tau = ? \qquad R = \frac{H(x)}{\tau} \qquad H(x) = 1 \Rightarrow$ vrijeme se traži za 1 bit

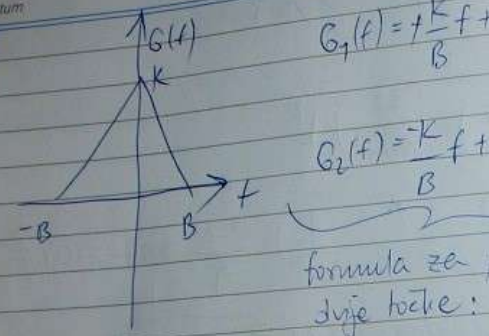
$R = \frac{1}{\tau} \Rightarrow \tau = \frac{1bit}{R} \qquad R = f_u \cdot r = 20000 \cdot 8 = 160000 bit/s$

$\tau = \frac{1}{160000 s^{-1}} = \boxed{6,25 \mu s}$

(49.) ??

Datum

(50)



$G_1(f) = +\frac{K}{B}f + K \quad (-B, 0)$

$G_2(f) = -\frac{K}{B}f + K \quad (0, B)$

formula za pravac kroz dvije točke:

1. slučaj $A(-B, 0)$, $C(0, K)$

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$$

isto za drugi slučaj i dobije se ono gore

$$P = \int_{-B}^{0} G_1(f)\,df + \int_{0}^{B} G_2(f)\,df = \int_{-B}^{0} \left(\frac{K}{B}f + K\right)df + \int_{0}^{B} \left(-\frac{K}{B}f + K\right)df$$

$$P = \frac{K}{B}\frac{f^2}{2}\Big|_{-B}^{0} + Kf\Big|_{-B}^{0} - \frac{K}{B}\frac{f^2}{2}\Big|_{0}^{B} + Kf\Big|_{0}^{B} = \frac{-K}{2B}\cdot B^2 + KB - \frac{KB^2}{2B} + KB$$

$$= -\frac{KB}{2} + 2KB = \boxed{KB}$$

(51) ??

Datum

(52)

$H(X) = 0{,}75 \cdot 10^6$

$S_N = 4 \cdot 10^{-18}\ W/Hz = \frac{N_0}{2}$ $\quad N_0 = 8 \cdot 10^{-18}\ W/Hz \cdot 10^3 = \boxed{8 \cdot 10^{-21}\ W/Hz}$

$Hz \sim Hz$

$T = 375\,s$

$R = \frac{H(X)}{T} = 2000$

$B = 1000\,Hz$

$N = N_0 B = 8 \cdot 10^{-18}$

$R = C = B\log_2\left(1 + \frac{S}{N}\right)$ $\quad S = 3N = \boxed{24 \cdot 10^{-18}}$

$2000 = 1000 \log_2\left(1 + \frac{S}{N}\right)$

$\frac{S}{N} = 4 - 1 = 3$

Wolfram

(53) $S_2 = x \cdot S_1$ $\quad N_1 = N_2 = N$ $\quad B_1 = B_2 = B$ $\quad \frac{S}{N} >>> 1$

$C_2 - C_1 = ?$

$C = B\log_2\left(1 + \frac{S}{N}\right)$

$C_2 - C_1 = B_2\log_2\left(1 + \frac{S_2}{N_2}\right) - B_1\log_2\left(1 + \frac{S_1}{N_1}\right)$ [možemo zanemariti 1 u logaritmu jer je $\frac{S}{N} >>> 1$]

$\left[N_1 = N_2 = N,\ B_1 = B_2 = N\right] \Rightarrow B\left(\log_2\left(\frac{S_2}{N} \Big/ \frac{S_1}{N}\right)\right) = \left|S_2 = xS_1\right| = B\log_2\left(\frac{xS_1}{S_1}\right)$

$= \boxed{B\log_2(x)}$ POVEĆANJE ZBOG + PREDZNAKA

Datum

Bilješke

(54.) $S = 1{,}9\ W$

$S_N = 7{,}5 \cdot 10^{-9}\ W/Hz \Rightarrow N_0 = 2S_N = 15 \cdot 10^{-9}$

Max kapacitet?

$$C = B\log_2\left(1+\frac{S}{N}\right) = B\log_2\left(1+\frac{1{,}9}{15\cdot 10^{-9}B}\right)$$

$C' = 0 \quad \left(B\log_2\left(1+\frac{1{,}9}{15\cdot 10^{-9}B}\right)\right)' = 0$ (nađemo B i uvrstimo poslije u C da dobijemo MAX)

- uvijek dalje radio!!!

(55) ??

(56) $S_S(f) = \begin{cases} \frac{a|f|}{B} & |f| \le B \end{cases}$ $\quad S_N = a\,10^{-10} \Rightarrow N_0 = 2a\,10^{-10}$

$|H(f)| = 0{,}8$

$|H(f)|^2 = 0{,}64$

$N = N_0 B$

$S_y = S_S \cdot |H(f)|^2$

$$S = 0{,}64 \cdot 2\int_0^B \frac{af}{B}\,df = aB \cdot 0{,}64$$

$$C = B\log_2\left(1+\frac{S}{N}\right) = B\cdot\log_2\left(1+\frac{aB\cdot 0{,}64}{2a\cdot 10^{-10}B}\right) = \boxed{31{,}57\ B}$$

Metha

(57.) $R_X(\tau) = e^{-0{,}5|\tau|}$

$S_N = \frac{N_0}{2} = S_{XN} \quad |H(f)|^2 = ?$

$S_{y_N}(\text{izlaz}) = S_{x_1}(f)$ (obični ulaz jednak je Gaussovom izlazu)

$S_{yN} = S_{XN} \cdot |H(f)|^2$

$$S_{x_1}(f) = \int_{-\infty}^{0} e^{0{,}5\tau} e^{j2\pi f\tau}\,d\tau + \int_{0}^{\infty} e^{-0{,}5\tau} e^{j2\pi f\tau}\,d\tau$$

$$= \frac{1}{0{,}5+j2\pi f} + \frac{1}{0{,}5-j2\pi f} = \frac{0{,}5+j2\pi f+0{,}5-j2\pi f}{0{,}25+4\pi^2 f^2} = \frac{1}{\frac{1}{4}+\frac{16\pi^2 f^2}{4}}$$

$$= \boxed{\frac{4}{1+16\pi^2 f^2}}$$

$$|H(f)|^2 = \frac{S_{yN}}{S_{XN}} = \frac{\frac{4}{1+16\pi^2 f^2}}{\frac{N_0}{2}}$$

$$\boxed{|H(f)|^2 = \frac{8}{N_0(1+16\pi^2 f^2)}}$$

Datum

(58) $u_{max}=8$

$\frac{\Delta}{2}=20\cdot10^{-6}$ $\quad r=?$

$\Delta=\frac{2u_{max}}{L}$ $\quad L=2^r$

$2^r=\frac{2u_{max}}{\Delta} \Rightarrow r=\log_2\left(\frac{2u_{max}}{\Delta}\right)=\log_2\left(\frac{16}{40\cdot10^{-6}}\right)$

$r=18,61$ bit (ZAOKRUŽIMO NA PRVU VEĆU)

$\boxed{r=19}$

(59) $B=4000$

$f_s=\omega n=2B=8000$

$L=8$

2 razine $p=0,25$ $\quad R=?$

2 razine $p=0,125$

4 razine $p=1/16$ $\quad R=f_s\cdot r=f_s\cdot H(x)$

$H(x)=2\cdot0,25\log_2(0,25)+2\cdot0,125\log_2(0,125)+4\cdot\frac{1}{16}\log_2\left(\frac{1}{16}\right)=2,75$ bit/smb

$R=8000\cdot2,75$

$\boxed{R=22000\ \text{bit/s}}$

Datum

(60) $s(t)=4\sin(2\pi35000t)$ $\quad S=\frac{4^2}{2}=8$

$f_{min}=?$ $\quad \left(\frac{S}{N}\right)=65dB=10\log_{10}X$ $\quad u_{max}=4$

$\left(\frac{S}{N}\right)=10^{6,5}$

$B=35000$ $\quad \left(\frac{S}{N}\right)=\left(\frac{3S}{u_{max}^2}\right)\cdot2^{2r}=\frac{3}{2}2^{2r}$

$R=f_s\cdot r=2B\cdot r$ $\quad r=\frac{\log_2\left(\frac{2\cdot10^{6,5}}{3}\right)}{2}=10,5$ (PRVU VEĆU)

$R=70000\cdot11$ $\quad \boxed{r=11}$

$\boxed{R=770\ \text{kbit/s}}$

(61) $\frac{E_{b1}}{N_0}=100$ $\quad \frac{\alpha_1^2P_1}{C_1N_0}=100$ $\quad$ ima sad formula: $\frac{E_b}{N_0}=\frac{2^{\frac{C}{B}}-1}{\frac{C}{B}}$

$\alpha_2=\frac{\alpha_1}{2}$ $\quad \boxed{\frac{E_{b2}}{N_0}=25}$ $\quad$ primjetimo $\frac{C}{B_1}=\log_2\left(100\frac{C}{B_1}+1\right)$

$B_1\neq B_2$

$P_1=P_2$ $\quad \frac{C}{B_1}=9,9617$

$C_1=C_2$ $\quad \frac{C}{B_2}=\log_2\left(25\frac{C}{B_2}+1\right)$ $\quad \frac{C}{B_2}=7,57216$

$\frac{B_2}{B_1}=?$

$\frac{B_2}{B_1}=\frac{9,9617}{7,57216}=\boxed{1,316}$

Shefino

Datum

(62.) $\int_{-\infty}^{\infty} \delta(t-10) \sin\left(\frac{\pi}{20} t\right) dt = ?$

$\int_{-\infty}^{\infty} \delta(t-t_0) \cdot x(t) = x(t_0)$

$= \sin\left(\frac{\pi}{20} t_0\right) = \left| t_0 = 10 \right| = \sin\left(\frac{\pi}{2}\right.$

$\boxed{= 1}$

(63.) ??

(64.) ??