TINF – DZ 8

40.) $C_\infty = \frac{1}{\ln 2} \cdot \frac{S}{\eta}$ [bit/s] $\qquad \frac{\eta}{2} = S_N = \frac{N_0}{2} \Rightarrow N_0 = \eta$

$$\lim_{B\to\infty} C = \lim_{B\to\infty} B \log_2\left(1 + \frac{S}{N_0 B}\right) = \lim_{B\to\infty} \log_2\left(1 + \frac{S}{N_0 B}\right)^B =$$

$$= \log_2\left(e^{\frac{S}{N_0}}\right) = \frac{\ln\left(e^{\frac{S}{N_0}}\right)}{\ln 2} = \frac{S}{N_0} \cdot \frac{1}{\ln 2} = \frac{S}{\eta} \cdot \frac{1}{\ln 2}$$

41.) $S_1 = 8\ W$ $\quad S_2 = ?$

$f_{1d} = 3100\ Hz$ $\quad f_{2d} = 200\ Hz$

$f_{1g} = 6600\ Hz$ $\quad f_{2g} = 2700\ Hz$

$B_1 = 3500\ Hz$ $\quad B_2 = 2500\ Hz$

$N_{01} = 10^{-10}\ W/Hz$ $\quad N_{02} = 10^{-12}\ W/Hz$

$$B_1 \log_2\left(1 + \frac{S_1}{N_{01}B_1}\right) = B_2 \log_2\left(1 + \frac{S_2}{N_{02}B_2}\right)$$

$$85561{,}5 = 2500 \cdot \log_2\left(1 + \frac{S_2}{2500 \cdot 10^{-12}}\right)$$

$$2 \cdot 10^{10} = 1 + \frac{S_2}{2500 \cdot 10^{-12}} \Rightarrow S_2 = 50{,}18\ W$$

$$A = 10 \log\left(\frac{S_2}{S_1}\right) = \boxed{7{,}97\ dB}$$

42.) $f_M = 8\,kHz \rightarrow B_1 = 4\,kHz$

$r = 8 \qquad L = 256 \qquad \left(\frac{S}{N_1}\right) = 20\,dB \qquad \Delta N = 3\,dB$

$20 = 10 \log\left(\frac{S}{N_1}\right) \rightarrow \frac{S}{N_1} = 100 \rightarrow S = 100 N_1$

$3\,dB = 10 \log_2 N_1 - 10 \log_2 N_2 = 10 \log \frac{N_1}{N_2} \Rightarrow \frac{N_1}{N_2} = 1{,}9953 N_1$

$\Downarrow$

$\frac{S}{N_2} = 199{,}53$

$R = f_M \cdot r = 64\,kbit/s$

$$B = \frac{R}{\log_2\left(1 + \frac{S}{N_2}\right)} = \boxed{8368\,Hz}$$

43.) $B_1 = 1800\,Hz$ $\quad S_1/N_1 = 30\,dB \rightarrow \frac{S_1}{N_1} = 1000$

$B_2 = B\,Hz$ $\quad S_2 = 5\,W \quad N_{02} = 10^{-6}\,W/Hz$

$R_L = 50\,kbit/s = C$

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

$$C_1 = B_1 \log_2\left(1 + \frac{S_1}{N_1}\right) = 17{,}941\ kbit/s$$

$$C = C_1 + C_2$$

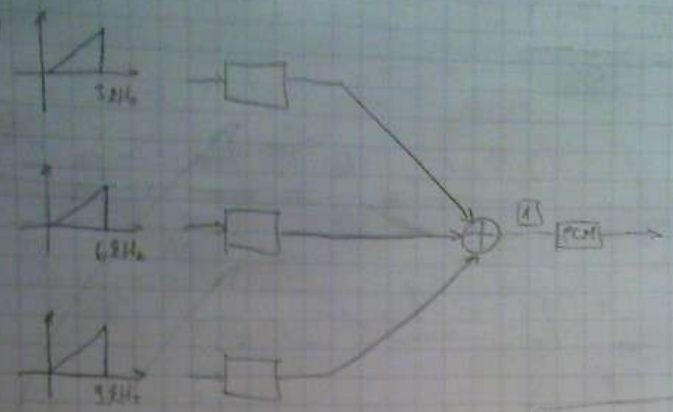
$$C_2 = 32{,}059\ kbit/s$$

$$C_2 = B_2 \log_2\left(1 + \frac{S}{N_{02} B_2}\right)$$

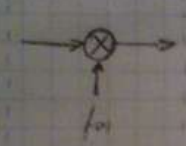
$$B_2' = \frac{50000 - 1800 \log_2(1001)}{\log_2\left(1 + \frac{5}{10^{-6} B_2}\right)} = \ldots = \boxed{23344\,Hz}$$

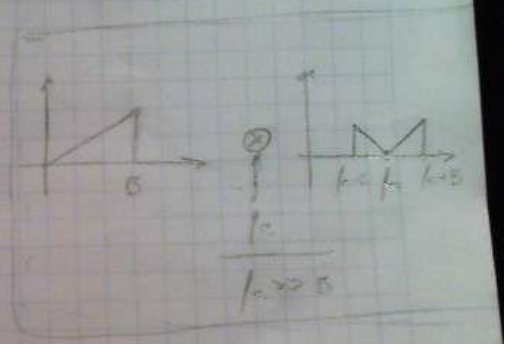
↳ TU SE STALNO U KRUG UVRŠTAVAJU VRIJEDNOSTI U B_2
(B_2 - PROIZVOLJAN $\rightarrow$ $B_2' \rightarrow B_2 = B_2' \rightarrow$ UVRSTI SE $B_2 \rightarrow B_2' \rightarrow \ldots$)
KADA SU B_2 i B_2' PRIBLIŽNO JEDNAKI, TO JE RJEŠENJE
(U OVOM SLUČAJU 8 KORAKA)

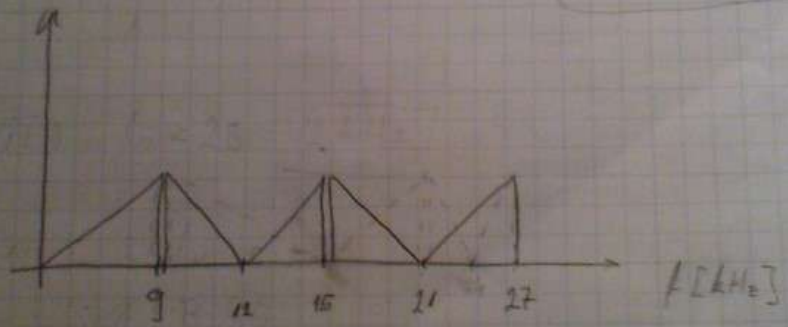
44.)



i)







f_1 = 12 kHz
f_2 = 21 kHz

ili

f_1 = 15 kHz
f_2 = 24 kHz

B_{min} = 27 kHz

ii) $f_u = 2B = 54$ kHz

iii) $M = 8$

$R = f_u \cdot M = 432$ bit/s

45.) $\frac{E_b}{N_0} = \frac{2^{C/B} - 1}{C/B}$

$$\lim_{B\to\infty} \frac{E_b}{N_0} = \lim_{B\to\infty} \frac{2^{C/B} - 1}{C/B} = \frac{0}{0} \overset{L'H}{=} \lim_{B\to\infty} \frac{-\frac{C}{B^2} \cdot 2^{\frac{C}{B}} \cdot \ln 2}{-\frac{C}{B^2}} =$$

$$= 2^0 \cdot \ln 2 = \ln 2 = 0{,}693$$

$$\frac{E_b}{N_0}\Big|_{dB} = 10 \log (0{,}693) = -1{,}59 \text{ dB}$$