Masovne - ELEKOM zadaci

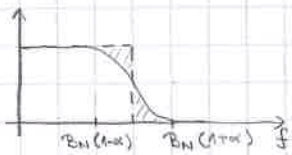
→ 1. auditorne

3. 128 razina + 1 sinkronizacijski bit
$B = 12$ kHz ; kvaternarni kod
$\alpha = 1$

$B = B_N (1+\alpha)$ B - širina pojasa
B_N - Nyquistova širina
α - faktor zaobljenja

Nyquistov filtar → ima pravokutnu karakteristiku

kosinusno zaobljeni filtar



$B_N = \frac{R_S}{2}$ osnovni pojas (bez modulacije)

R_b - brzina prijenosa bita

$R_b = w \cdot R_S$ $R_b \geq R_S$ jer je w uvijek ≥ 1

! R_S [Bd]

$R_b = \frac{1}{T_b}$ $R_S = \frac{1}{T_S}$

T_b - trajanje bita
T_S - trajanje simbola

$B = B_N (1+\alpha)$

$B_N = \frac{B}{1+\alpha}$ [Hz]

$B_N = \frac{R_S}{2}$

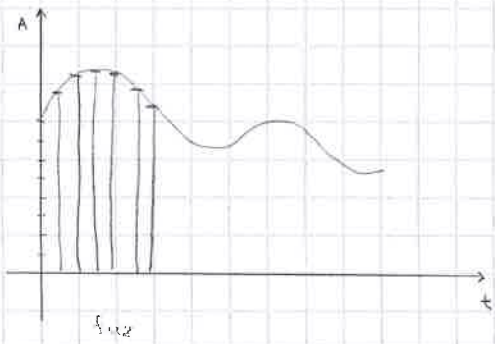
$R_S = 2 \cdot B_N =$ [Bd]

$R_b = \_\_ \cdot R_S$ kvaternarni kod → ima 4 stanja
za svako stanje : 2 bita
$w = 2$

$R_b = 2 \cdot R_S =$

$f_{uz} = 2 f_{max}$ → iz Shannonovog teorema

$R_b = f_{uz} \cdot n$



$n = \log_2 (\text{svih stanja})$

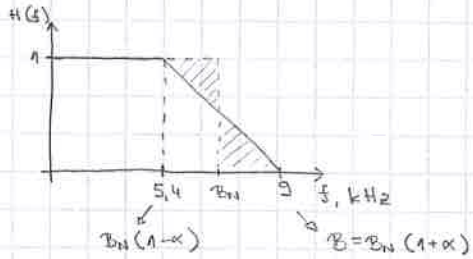
$R_b = f_{uz} : n$

↘ 7 + 1

↘ sinkronizacijski bit

$f_{uz} = \frac{R_b}{n}$ $f_{max} = \frac{f_{uz}}{2}$

4. binarni linijski kod



$R_b = R_s$ → jer je binarni

$$B_N = \frac{9-5,4}{2}$$

$$B_N = \frac{R_s}{2}$$

$$R_s = 2\,B_N$$

$$R_b = 2 \cdot B_N \quad [bit/s]$$

$$SU = \frac{R_b}{B}$$ spektralna učinkovitost

$B = 9$!

S.U $[bit/s/Hz]$

8.

$$A, G|_{dB} = 10 \log\left(\frac{P_{izl}}{P_{ul}}\right)$$

$$L|_{dB} = 10 \log\left(\frac{P_{ul}}{P_{izl}}\right)$$

! $\log(x \cdot y) = \log x + \log y$

$-7 + 10 - 3 + 10 = 10$ dB

$\frac{P_i'}{P_i} = 10$ dB

10. $N = k \cdot T \cdot B$ → termički šum

k - Boltzmanova konstanta

$N\ [W]$

9. $N_0 = k \cdot T$ → gustoća snage termičkog šuma

$N_0\ [W/Hz]$

11. $C = 2BW$ → Nyqvistova formula

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

! $\frac{S}{N}$ - u apsolutnoj vrijednosti, ne u dB

12. $B = 2{,}2725 - 2{,}2675$

$\frac{S}{N}$ → preračunamo iz dB-a

11. zadatak → jesenski ispitni rok 2011/12

$P = 100$ W
$r = 100$ m
$f = 1800$ MHz

$L = 10 \log\left(\frac{4\pi d}{\lambda}\right)^2$ gušenje u slobodnom prostoru

d - udaljenost
λ - valna duljina

$\lambda = \frac{c}{f} = \frac{3 \cdot 10^8}{f}$

$P = 100$ W $= 20$ dB → odašiljana snaga

primljena snaga $P_{PR} = P - L$ sve u dB

→ 2. auditorne

1. AM

$R = 50\,\Omega$
$f_m = 1\ kHz$
$P_p = 100\ W$
$P_{AH} = 118\ W$

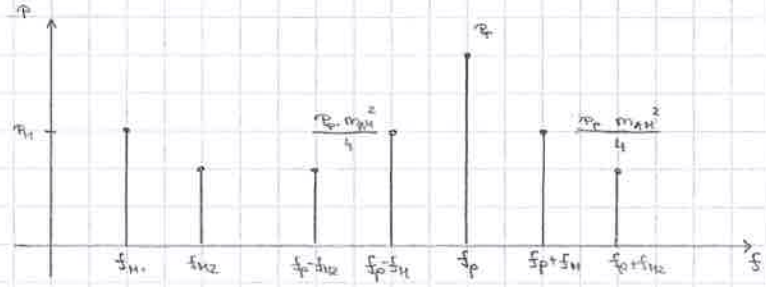
$m_{AM} = \frac{U_H}{U_p}$ indeks modulacije

$P_{AH} = P_p \left(1 + \frac{m_{AM}^2}{2}\right)$

$P_p = \frac{U_p^2}{2R}$ $\qquad U_p = \sqrt{2 \cdot P_p \cdot R}$

$U_{MAX} = U_p (1 + m_{AM})$ $\qquad U_{MIN} = U_p (1 - m_{AM})$

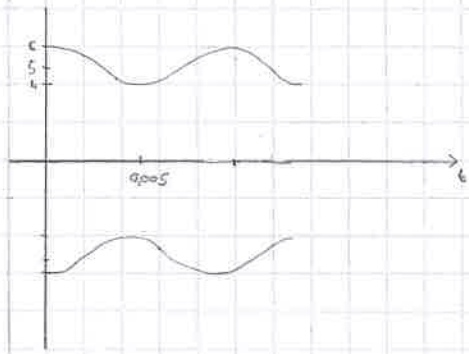
$P_{AH} = P_p \left(1 + \frac{m_{AM1}^2}{2} + \frac{m_{AM2}^2}{2} + \dots\right)$



1. zadatak → 1. međuispit 2011/12

$U_p = 5 \cos(4000\pi t)$
$U_H = \cos(200\pi t)$

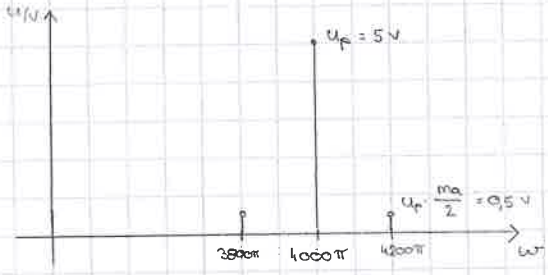
$U_p = 5\ V$
$U_H = 1\ V$
$m_{AM} = \frac{U_H}{U_p} = \frac{1}{5}$



$\omega_p = 4000\pi \rightarrow T_p = 5 \cdot 10^{-4}\ s$

$\omega_m = 200\pi \rightarrow T_m = 0{,}01\ s$

kosinus → počinje s maksimumom



. zadatak → završni ispit 2011/12

$U_{MIN} = 40$ V_{pp}
$U_{MAX} = 80$ V_{pp}
$f_p = 100$ kHz
$f_m = 10$ kHz

$U_{MIN} = 20$ V
$U_{MAX} = 40$ V

$m_{AM} = \frac{U_M}{U_p}$

$U_p = \frac{U_{MIN} + U_{MAX}}{2}$

$U_{MAX} = U_p (1 + m_{AM})$

$m_{AM} = \frac{U_{MAX}}{U_p} - 1$

$R = 50\ \Omega$

$P_{AM} = P_p \left(1 + \frac{m_{AM}^2}{2}\right)$

$P_p = \frac{U_p^2}{2R}$

. FM

$B = 2 (f_m + \Delta f)$ Carsonovo pravilo

f_m - modulacijska frekvencija
Δf - devijacija

$m_{FM} = \frac{\Delta f}{f_M}$

$P_{FM} = P_p$ $P_{FM} = \frac{U_{FM}^2}{2R}$ → $U_{FM} = \sqrt{2RP}$

$U_{FM,eff} = \frac{U_{FM}}{\sqrt{2}}$

$m_{FM} > 0,4$ širokopojasna
$m_{FM} < 0,4$ uskopojasna

25. zadatak → zimski ispitni rok 2011/12

$\Delta\phi = 2\ rad = m_{FM}$

$m_{FM} = \frac{\Delta f}{f_m}$ → $\in \langle 300, 3400 \rangle$

uvrstimo granične

$\Delta f_1 =$
$\Delta f_2 =$

$f_{uz} = 2 \cdot f_H = 2 \cdot 3400$

$B_1 = 2(\Delta f + f_H)$

uvijek uzimamo najveće → gledamo najgori slučaj

$B = B_1(1+\alpha)$

26. zadatak → zimski ispitni rok 2011/12

$f_p = 100\ MHz$
$f_H = 15\ kHz$
$\Delta f = 75\ kHz$
$R = 50\ \Omega$
$u_p = 100\ V$
$u_H = 8\ V$

$P_{FM} = P_p = \frac{u_p^2}{2R}$

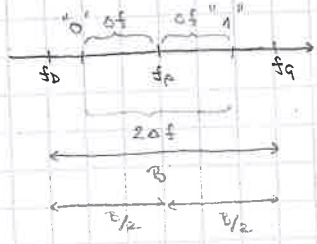
modulacija jednim tonom - modulacijski signal se sastoji od samo jedne frekvencije

3. auditorne

$f_0 = 1300$ Hz
$f_1 = 2100$ Hz

BFSK

$$f_p = \frac{f_0 + f_1}{2}$$



$$f_1 - f_0 = 2\Delta f$$

$$m_{FSK} = \frac{\Delta f}{f_H}$$ ne koristimo jer nikad ne znamo f_H

$$m_{FSK} = 2\Delta f T_s \qquad T_s = \frac{1}{R_s}$$

binarni : $R_b = R_s$

$$B = 2\left(\Delta f + \frac{1}{2T_b}\right)$$ širina pojasa

$$f_p = f_p - \frac{B}{2} \qquad f_g = f_p + \frac{B}{2}$$

PSK

$B_N = R_s$ za sve PSK

$R_b = 8,448$ Mbit/s
$f_p = 2,4$ GHz

QPSK : 1 simbol → 2 bita : $R_b = 2R_s$

$B = B_N(1+\alpha)$

3. prva nultočka: $f_p - \frac{1}{T_s}$ i $f_p + \frac{1}{T_s}$ → širina: ovisno o broju bitova

maksimum: za f_p

- HSK - izmjenka

$R_s = 12\ MBd$

8 PSK $\quad R_b = 3 R_s = 36\ Mbit/s$

$S.U. = \frac{R_b}{B} \quad \left[\frac{bit/s}{Hz}\right]$

$B_N = R_s = 12\ MHz$

$B = B_N (1+\alpha)$

4. QPSK

$R_b = 19200\ bit/s$
$\alpha = 0,5$
$P_{UL} = 1\ nW$
$N_0 = 6 \cdot 10^{-15}\ Ws$

$R_b = 2 R_s$

$N = kTB = N_0 \cdot B$

$B_N = R_s = \frac{R_b}{2}$

$B = B_N (1+\alpha)$

$\frac{P_{UL}}{N} =$ u W ili dB

$P = \frac{E_s}{T_s} \qquad E_s = P_{UL} \cdot T_s = P_{UL} \cdot \frac{1}{R_s} \quad [Ws]$ ili $[J]$

$\frac{E_s}{N_0} =$

3.3.2 → treći labos

$f_g = f_p + \frac{3}{4} R_b$

amplituda: $20 \log \frac{x_1}{x_2} = -40$ dB

$x_2 = 0{,}01$

tražimo točku gdje je -40 dB i očitamo za koju frekvenciju

13. zadatak → 2. međuispit 2008/2009

$R_b = 200$ kbit/s

937,2
,4 MHz → 4-FSK : $m_{FSK} = 2 \Delta f T_S$
,6
,8 $R_b = 2 R_S$

$2\Delta f = 937{,}4 - 937{,}2$

3. zadatak → završni ispit 2011/12

$R_b = 110$ Mbit/s
$B = 2{,}5$ MHz
$\alpha = 0{,}25$

$B = B_N (1+\alpha)$
$B_N = \frac{B}{1+\alpha}$

ostvariva brzina? jedino za PSK možemo izračunati:

$R_S = B_N$

$SU = \frac{R_b}{B} = \frac{R_b}{B_N(1+\alpha)} = \frac{R_b}{R_S(1+\alpha)} \approx 5{,}5$ → gledamo za veću

$2^6 = 64$ → 64-QAM

64-QAM ima puno veću otpornost na smetnje od 64-PSK

$2^{4.0}$
2^{11}

13. zadatak → zimski ispitni rok 2011/12

MSK

$$f_1 = f_p + \frac{1}{4T_b}$$

$$f_0 = f_p - \frac{1}{4T_b}$$

FSK: $\Delta\phi = \pm \pi m_F$

MSK → poseban slučaj. $m_F = 0{,}5$

$$\Delta\phi_{MSK} = \pm \frac{\pi}{2}$$

3. zadatak → 1. međuispit 2011/12

$$10 \log \frac{E_{b1}}{N_0} = 9{,}9$$

$$10 \log \frac{E_{b2}}{N_0} = 18{,}5$$

$$\Delta E_b = 8{,}6 \text{ dB}$$

$$= 7{,}44 \text{ puta}$$