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Communication Sys A-6

Q:-1 (6.1-5)

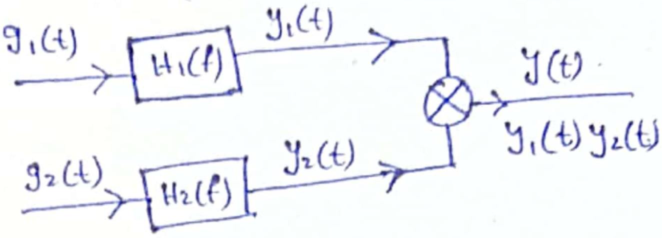
$g_1(t) = 10^4 \Pi(10^4 t)$, $g_2(t) = \delta(t)$

$H_1(f) = \Pi(f/20000)$, $H_2(f) = \Pi(f/10000)$

Solve

$g_1(t) \rightleftharpoons G_1(f)$

$g_2(t) \rightleftharpoons G_2(f)$



$G_1(f) = \text{sinc}(10^{-4}\pi f)$, $G_2(f) = 1$

Here $B_{H_1} = 10\,KHz$ and $B_{y_1} = 10\,KHz$

$f_s = 2B = 2(10000) = 20000 = 20\,KHz$

where as ~~B_{H_2}~~ $B_{H_2} = 5\,KHz$, half of the freqvency

$f_s = 2B_{H_2} = 2(5000) = 10000 = 10\,KHz$

from the convolution property, the convolution of two signal / functions in the time domain is equals to the product of two signals/functions in the frequency domain and ~~vise v~~ vice versa, so the ~~frequency~~ of $y(t)$ will be the sum of freq of $y_1(t)$ and $y_2(t)$

$B_y = B_{y_1} + B_{y_2}$

$B_y = 10K + 5K = 15\,KHz$

$f_y = 2(B_y) = 2(15K)$

$f_y = 30\,KHz$

Q:-2 (6.2-2) $B = 4.5\ MHz$

(a) Sampling rate above 20% Nyquist rate.

$N_{rate} = 2B = 2(4.5M)$

$N_{rate} = 9MHz$

Sampling Rate $= 9MHz \times 1.2$

Sampling Rate $= 10.8MHz = S_R$

(b) Levels $= L = 1024$

number of bits $= n = \log_2(L)$

$n = \log_2(1024)$

$n = 10$

A total of 10 binary pulses are required to encode each samp

(c) $S_R = 10.8MHz$, $n = 10$

Pulse Rate $= (n)(S_R) = (10)(10.8) = \cancel{108 MHz}$

Pulse Rate $= 108\ M\ bits/s = 108\ MbPs$

$B_{min} = \frac{(\text{Pulse Rate})}{2} = \frac{108\ M}{2}$

$B_{min} = 54\ MHz$

Q: 3 (6.2-6)

$$m(t) = \begin{cases} e^{-t/10} & 0 \le t \le \pi \\ e^{-\frac{(t-\pi)}{10}} & \pi \le t \le 2\pi \end{cases}$$

$T = 2\pi$

$m_p = A_m = 1$

SQNR = ~~4.3 dB~~ 43 dB

Solve

$$P_m = \overline{m^2(t)} = \frac{1}{T}\int |m(t)|^2 dt$$

$$= \frac{1}{2\pi}\left[\int_0^{\pi}(e^{-t/10})^2 dt + \int_{\pi}^{2\pi}\left(e^{-\frac{(t-\pi)}{10}}\right)^2 dt\right]$$

$$= -\frac{5}{2\pi}\left[e^{-\frac{\pi}{5}} - e^{0} + e^{-\pi/5} - e^{0}\right]$$

$$Avg(P_m) = +\frac{5}{\pi}\left[1 - e^{-\pi/5}\right] = 0.74247 \text{ W}$$

Now

$$SQNR = 10\log_{10}\left[3L^2 \frac{\overline{m^2(t)}}{m_p^2}\right] = 10\log_{10}\left[3L^2\left[\frac{0.74247}{1}\right]\right]$$

$$43 = 10\log_{10}(2.22743L^2)$$

$$L^2 = 8957.688 \quad , \quad L = 94.645$$

n = no of bits = $\log_2(L) = 6.564 = 7$ bits

Now ~~SN~~ SQNR = ?

$$SQNR = 10\log_{10}\left(3L^2 \frac{\overline{m(t)^2}}{m_p^2}\right) = 10\log_{10}\left[3(8957.688)\frac{(0.74247)}{1}\right]$$

$$SQNR = 10\log_{10}(19950.5627)$$

$$SQNR = 3L^2 \frac{\overline{m(t)^2}}{m_p^2}$$

$$SQNR = 42.9995515 \text{ dB}$$

Q:- 4 (6.2 - 9)

$B = 240\ Hz$, $n = 9$ bits , $R_N = 2B = 480 Hz$

Actual Nyquist Rate $= R_{AN} = 480(1.2) = 576 Hz$

Bit rate $= (9)(576) = 5184$ bps

as framing and synchronising requires 0.5% extra bits so,

$5(5184)(1.005) = 26049.6 \approx 26050$

B required $= \frac{26050}{2} = 13025\ Hz = 13025\ Hz$

Power $= S_o = \frac{m_p^2}{2}$

Q:- 5 (6.7-1)

Sampling Rate $=$ ~~64Hz~~ $64 KHz = S_R$

$A_{max} = 1$

(a) $E = ?$

$A_{max} = \frac{E f_s}{\omega}$

$m(t) = A_m \sin \omega_m t$ × , let $m(t) = A_m \cos \omega_m t$

$|\dot{m}(t)|_{max} = \omega A < E f_s$, $A_{max} = \frac{E f_s}{\omega}$

$E \geq (2\pi f_m A_m)\left(\frac{1}{f_s}\right)$

$E \geq (2\pi f_m)\left(\frac{1}{2f_m}\right)$

$E \geq \pi$

$E_{min} = \pi = 3.1416$

(b) $N_o = ?$ $B = 3.4 KHz$

$N_o = \frac{E^2}{3}\left(\frac{f}{f_s}\right) = \frac{E^2}{3}\left[\frac{S_R}{B}\right] = \frac{(3.1416)^2}{3}\left[\frac{(3400)}{64000}\right]$

(b) $N_o = ?$, $B = 3.4\,KHz$

Solve

$$N_o = \frac{(E)^2}{3}\left[\frac{B}{S_R}\right] = \frac{(3.1416)^2}{3}\left[\frac{3.4\,KHz}{64\,KHz}\right]$$

~~$N_o = 0.14$~~

$$\boxed{N_o = 0.17477}$$

(c) let $m(t) = A_m \sin\omega_m t$

$$S_o = \frac{A_m^2}{2} = \frac{(1)}{2} = 0.5\,W$$

SNR → Signal to noise Ratio $= \frac{S_o}{N_o} = \frac{0.5}{0.17477}$

$SNR = 2.86083$

(d) $$S_o = \int_{-1}^{1} x^2 (1/2)\, dx = \frac{1}{2}\left[\frac{x^3}{3}\right]\Big|_{-1}^{+1} = \frac{1}{3}$$

$$SNR = \frac{S_o}{N_o} = \frac{1/3}{0.17477}, \quad SNR = 1.908$$

(e) $$B_{T_{min}} = \frac{S_R}{2} = \frac{64000}{2}$$

$$B_{T_{min}} = 32\,KHz$$