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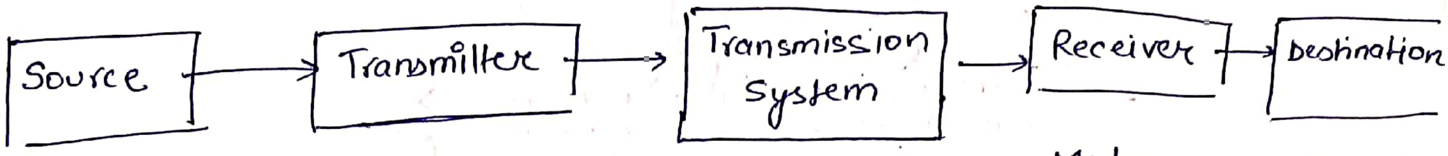
180433

CS425 Assignment 1

(1)



Eg. Mobile phone, Tablet — Modem — Telephone Network, Cordless Cables — Modem — Server

(3) $f(t) = (100 \cos t)^2$

$\Rightarrow 100 \cos^2 t = 100\left(\frac{1+\cos 2t}{2}\right)$ { Trigo identity }

$f(t) \Rightarrow 50(1+\cos 2t)$

From $f(t)$ we can see $2\pi f = 2$

$f = \frac{1}{\pi}$

$\boxed{T = \frac{1}{f} = \pi}$ Ans.

(2) The layered design has following advantages:

(a) It improves flexibility, maintainability and scalability

(b) It provides resillience and stability

(c) It provides extensibility and abstraction

The following are some of the disadvantages of layered architecture:

(a) Functional duplication

(b) The difficulty of detecting poor interactions b/w layers

(c) Data overhead and processing

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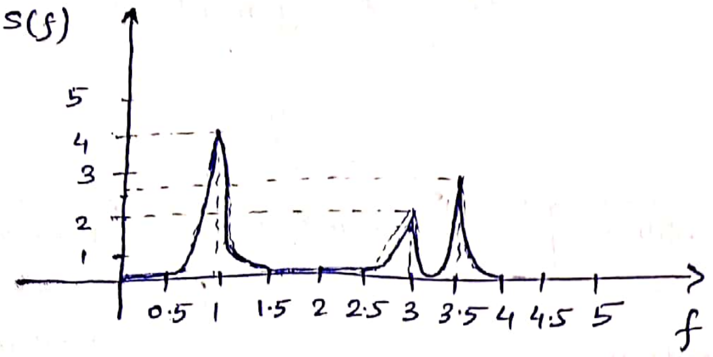
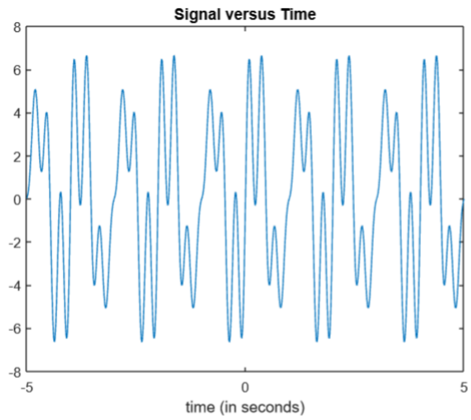
(4) $S(t) = 4\sin(2\pi t) + 2\sin(6\pi t) + \left(\frac{8}{\pi}\right)\sin(7\pi t)$





s(t) vs t

Frequencies in $s(t) \Rightarrow 1, 3, 3.5$

Absolute Bandwidth of spectrum $= \max(f) - \min(f)$

$f_{max} = 3.5\ Hz$; $f_{min} = 1\ Hz$

$\boxed{\text{Absolute Bandwidth} = 2.5\ Hz}$

(*) Effective bandwidth takes into account the frequencies which account for the max. energy of the signal.

↳ So effective bandwidth $= 3.5 - 1$

$= \underline{2.5\ Hz}$

(*) We see absolute bandwidth = effective bandwidth of signal which is expected since for a signal with finite absolute bandwidth effective and absolute bandwidths are same.

(5) SNR = 3dB = $10^{0.3}$ = 1.995

Bandwidth = B = 300Hz

Applying Shannon's assumption equation :

$C = B\log_2(1+SNR)$

$= 300 \times \log_2(1+1.995)$

$= 300 \times 1.583$

$= 474.9$ bps

Channel capacity = 474.9 bits per sec.

(6) signal encoding with 4 bits word ; Given c = 9600 bps

$M = 2^4 = 16$

Applying Nyquist's assumption eq^n :

$C = 2B\log_2 M$

$9600 = 2B\log_2 16$

$\boxed{B = \frac{9600}{2 \cdot 4} = 1200\ Hz}$ → min. required bandwidth

(7) Thermal ~~noise~~ noise is given as

$\boxed{N = kTB}$

$T = 50^\circ C = 323\ K$

$B = 10kHz$

$N = ~~1.38\times10^{23}~~ 1.381 \times 10^{-23} \times 323 \times 10 \times 10^3$

$= 446.06 \times 10^{-19}$

$\Rightarrow 4.46 \times 10^{-17}\ W$ ⇒ $\boxed{N_{dB} = 10\log_{10}(N) = -163.51 dBW}$

↓

Thermal Noise level (Ans)

(9) Voltage Gain $= 30\,dB$

$$30 = 10\log\left(\frac{V_2}{V_1}\right)^2$$

$$\boxed{\frac{V_2}{V_1} = 10^{1.5} = 31.623}$$

(8) $s(t) = \sin(2\pi f_1 t) + \frac{1}{3}\sin(2\pi(3f_1)t) + \frac{1}{5}\sin(2\pi(5f_1)t) + \frac{1}{7}\sin(2\pi(7f_1)t)$

$T = 1ms \Rightarrow f' = \frac{1}{T} = 1\,kHz = f_1$

→ Low pass filter of 8kHz implies that frequencies greater than ~~8kHz~~ 8kHz will not pass

→ frequencies in s(t) ⇒ 1kHz, 3kHz, 5kHz, 7kHz

↓

highest frequency = 7kHz < 8kHz and hence all frequencies pass through filter

(a) Avg. power $= \frac{A^2}{2}$

Avg. power of output waveform ⇒ $\frac{1}{2}\left(1^2 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2}\right)$

$= 0.586\,W$

(b) $B = 8\,kHz$; Output Noise Power : $N = BN_0$

$N_0 = 0.1\,\mu W/Hz$

$N = 0.8\,mW$

Output SNR $= \frac{\text{Output signal power}}{\text{Output Noise Power}}$

$= \frac{0.586}{0.8 \times 10^{-3}} = 732.5$

$SNR_{dB} = 10\log(SNR) = 10\log(732.5) = 28.65\,dB$

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