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CS-425-Assign 1

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① The simple model of communication is shown below:

Source → Transmitter → Transmission System → Receiver → Destination

Example of Source: Workstation
Transmitter: Modem
Transmission System: Public Telephone Network
Receiver: Modem
Destination: Server

② Advantages of layered architecture:–

→ Reduces Complexity: It breaks network communication into smaller, simpler parts, thus aiding component development, design and troubleshooting.

→ Standardises interfaces: Standardises network components to allow multiple vendor development and support.

→ Facilitates modular engineering: Allows different types of network hardware and software to communicate with each other.

→ Interoperability → It prevents changes in one layer from affecting the other layers, allowing for quick development.

→ Accelerates evolution → It provides for effective updates and improvements to individual components without affecting other components or having to rewrite the entire protocol

Disadvantages of layered architecture:

→ There might be a negative impact on the performance as we have the extra overhead of passing through layers instead of calling a component directly.

- The use of layers adds complexity to simple applications
- changes to lower level interfaces tend to percolate to higher levels.
- Complexity of identifying bad interaction b/w layers.

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Date ___/___/___

(3) $f(t) = (10\cos t)^2 = 100\cos^2 t = 100\left(\frac{1+\cos(2t)}{2}\right) = 50 + 50\cos(2t)$

→ Period $= \frac{2\pi}{\omega} = \frac{2\pi}{2} = \boxed{\pi}$

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

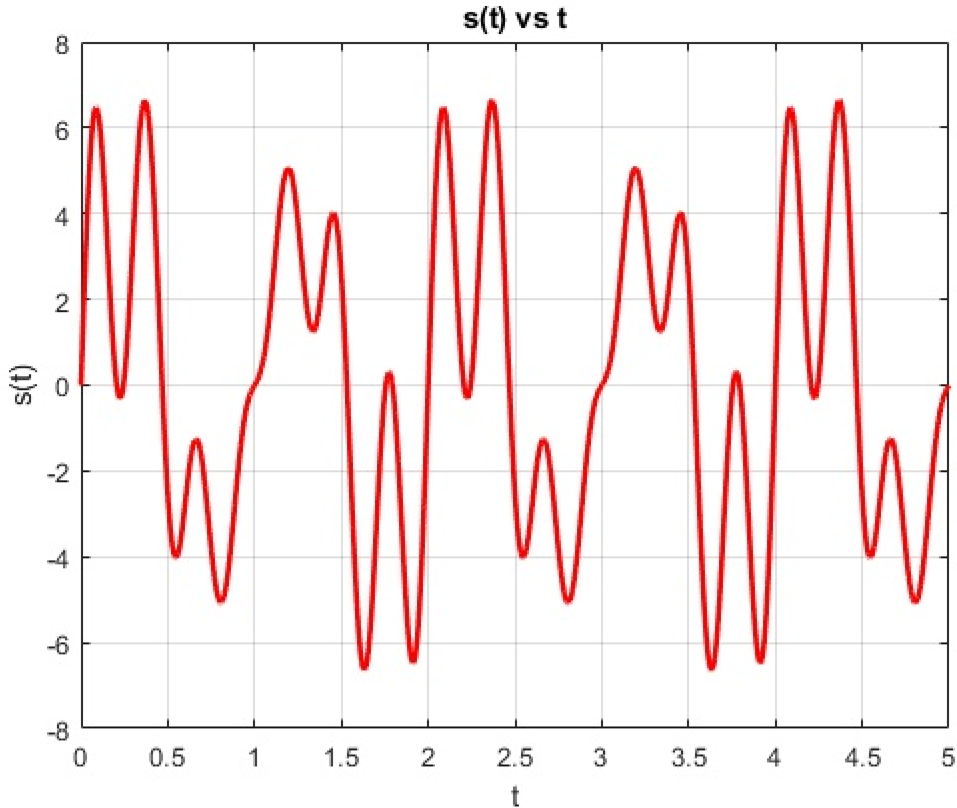
Frequencies: 1, 3, 3.5 Hz

Highest freq = 3.5 Hz
Lowest freq = 1 Hz

Absolute bandwidth = $3.5 - 1 = \boxed{2.5\text{ Hz}}$

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

→ for a signal with finite absolute bandwidth, effective bandwidth is same as that of absolute bandwidth.



s(t) vs t
s(t)
t
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

(5) White thermal noise present $\Rightarrow$ Shannon Capacity

$C = B\log_2(1+SNR)$. Here, $B = 300Hz$, $SNR_{dB} = 3dB$

$\therefore SNR = 10^{3/10}$

$\therefore C = 300 \times \log_2(1+10^{0.3}) = \boxed{474.80\,bps}$

(6) $C = 9600bps$, $K = 4$ bits

$\therefore M = 2^k = 2^4 = 16$

Noise free $\rightarrow$ Nyquist Capacity $\rightarrow$ $C = \log_2(M) * 2B$

$\therefore B = \dfrac{C}{2\log_2(M)} = 9600/2\log_2(16) = \boxed{1200Hz}$

(7) $B = 10^4 Hz$, $S = 10^3 W$, $T = 50^\circ C = 273+50\,K = 323\,K$

$N = KTB = 1.38 \times 10^{-23} \times 323 \times 10^4 = 4.457 \times 10^{-17}\,W$

$\therefore N_{dB} = 10\log_{10}(N/1W) = \boxed{-163.509\,dBW}$

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

$T = 1ms \Rightarrow f_1 = 1/T = 1\,kHz$
Low pass filter freq = 8 kHz

a) Output power → $P_{out} = \frac{1}{2} \times \sum A_i^2 = \frac{1}{2}\left(1 + \frac{1}{9} + \frac{1}{25} + \frac{1}{49}\right)$

$\therefore \boxed{P_{out} = 0.5857W}$

b) $N_0 = 0.1\mu W/Hz$ $\therefore N = N_0 B = 0.1 \frac{\mu W}{Hz} \times 8\,kHz = 800\mu W$

$SNR_{dB} = 10\log_{10}(P_{out}/N) = 10\log_{10}\left(0.5857/800\times10^{-6}\right)$

$\therefore \boxed{SNR_{dB} = 28.64\,dB}$

⑨ $G_{dB} = 20\log_{10}(A)$, given $G_{dB} = 30dB$

$\therefore A = 10^{30/20} = 10^{1.5} = \boxed{31.623}$