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Subject: Communication system

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x ———————————————— x

Q No: 1

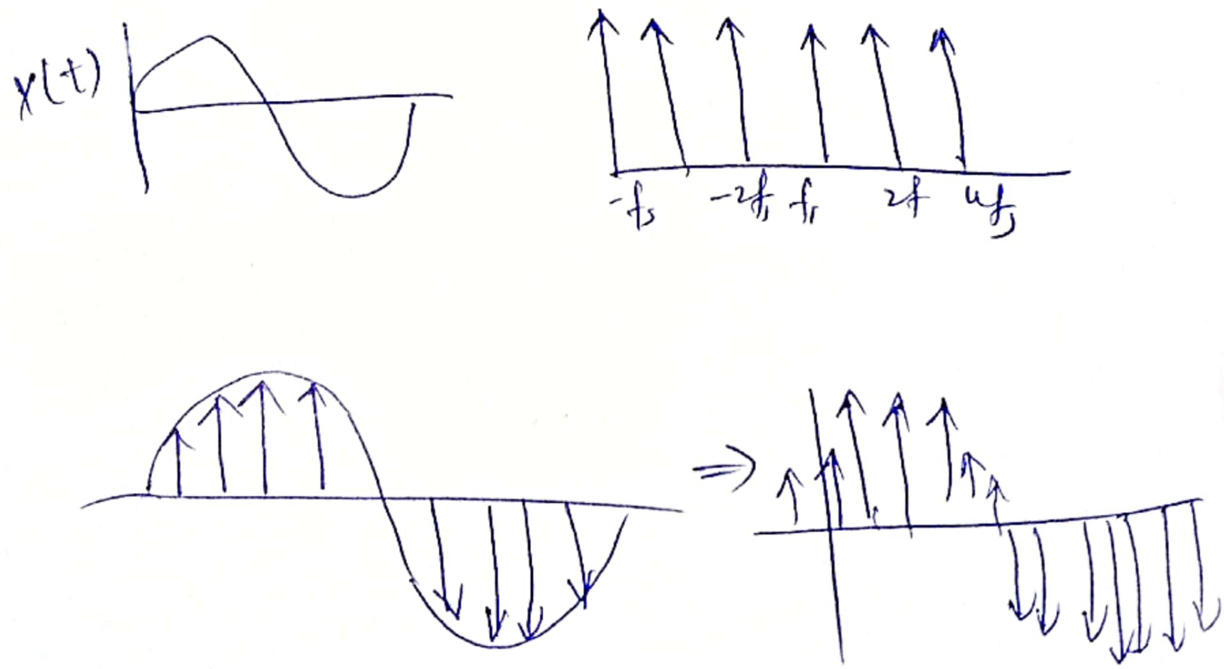
Data: $f_m = 250 H.$ f_s

(a) Nyquist Rate

$N_R > 2f_m$

$= 2 \times 250 = 500Hz$

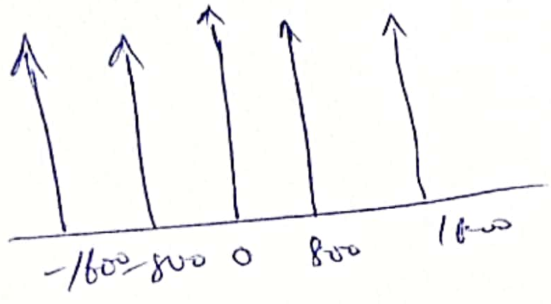
(b)



(c) Cut off frequency.

$$f_c = \frac{1}{2\pi CR} \Rightarrow \frac{1}{2 \times 3.14 \times 500} = 0.0003$$

(d) $f_s = 800\,Hz$.



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Q No: 2

(a) Let $x(t)$ be a Signal with Nyquist rate w_0. Determine the Nyquist rate for each of the following Signal.

(a) $x(t) + x(t-1)$

(b) $\frac{dx(t)}{dt}$.

Sol:

Nyquist rate = 2 × Maximum signal frequency

⇒ Sampling rate Must exceed Nyquist rate in order to be able to fully reconstruct the Signal.

(a) $y(t) = x(t) + x(t-1)$

Fourier transform → $Y(jw) = jwX(jw)$

Since the Max. frequency for $Y(jw)$ is same as $X(jw)$ then $Y(t)$ Nyquist rate is also w_0.

(b) $y(t) = x^2(t)$

We can rewrite the above

Fourier Transform $\rightarrow$ $Y(j\omega) = j\omega X(j\omega)$

Since the maximum frequency for $Y(j\omega)$ is the same as $X(j\omega)$ then $y(t)$ Nyquist rate is also ω_0.

x ———— x

Q No: 2

(b)

Sol: $\omega_m = 400\pi \ \frac{rad}{sec}$

Data: $f_m = \frac{\omega_m}{2\pi} \Rightarrow \frac{400\pi}{2\pi}$

$f_m = 200$ Hz.

$\omega_s = 300$ Hz X

$f_s = 300$ Hz.

$f_c = 150$ Hz.

$$s(t) \longrightarrow \underset{}{\overset{\text{Ideal}}{\boxed{LPF}}} \longrightarrow M_r(t)$$

$S(\omega) \cdot nf_s \pm f_m$

freq comp?

$n \Rightarrow 0 \pm f_m = \pm 200$ Hz.

$n = 1 \quad f_s \pm f_m = 500\text{Hz}, 100\text{Hz}.$

$n = -1 \Rightarrow -f_s \pm f_m \Rightarrow -100, -500$

$f_c = 150$ Hz.

-150 Hz to $+150$ Hz.

The frequency present in the reconstructed signal is 100 Hz.

Q No: 3

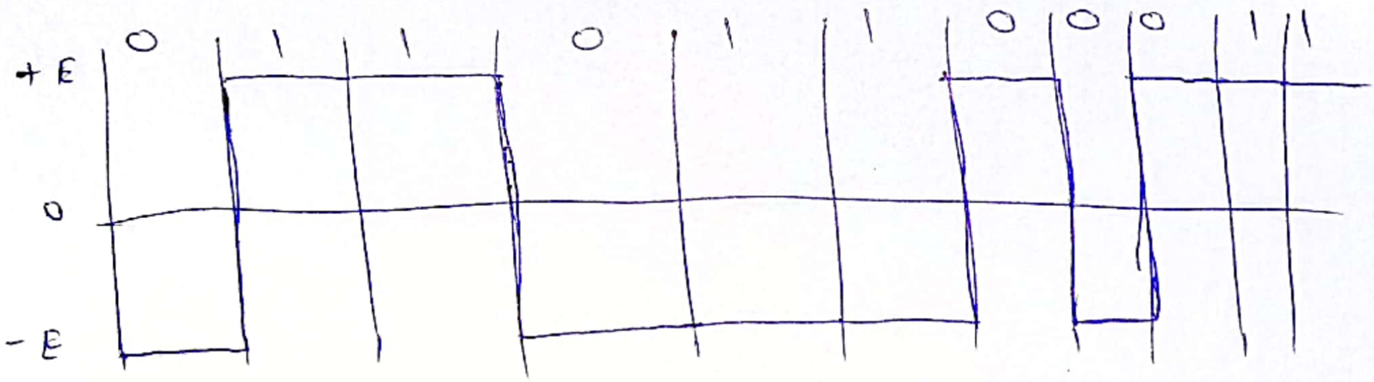
Sol: Code :

0 1 1 0 1 1 0 0 0 1 1

(a) NRZ-S

⇒ "One" is Represented by No change in Level.

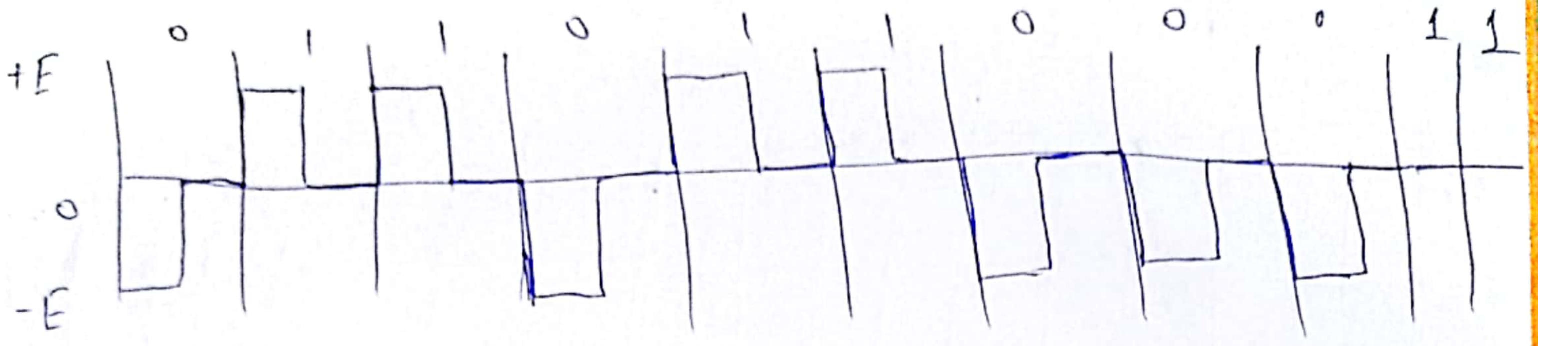
⇒ "Zero" is represented by change in Level.



(b) Polar-RZ

One and zero are Represanted by opposite level pulses that are one half bit in width-

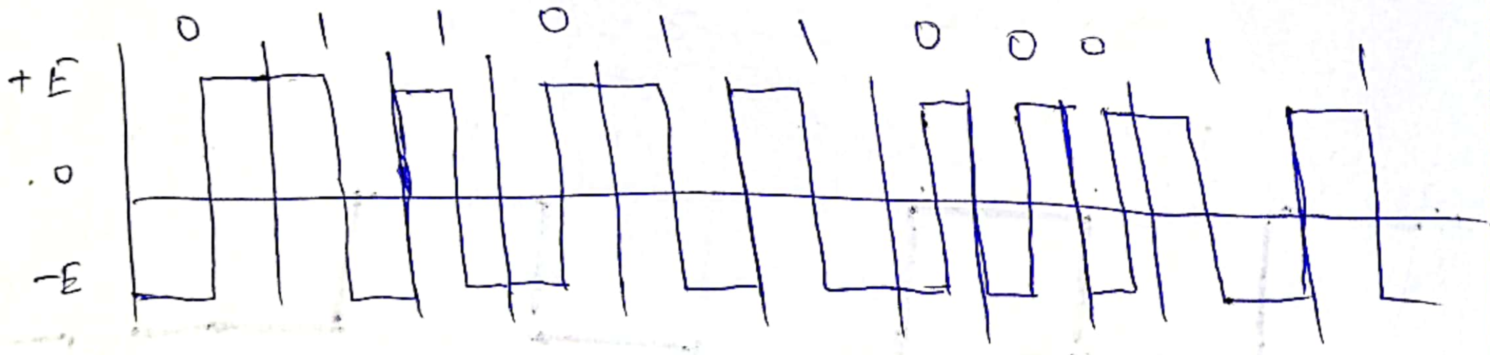
Graph:



(C) Spilit Phase Manchester.

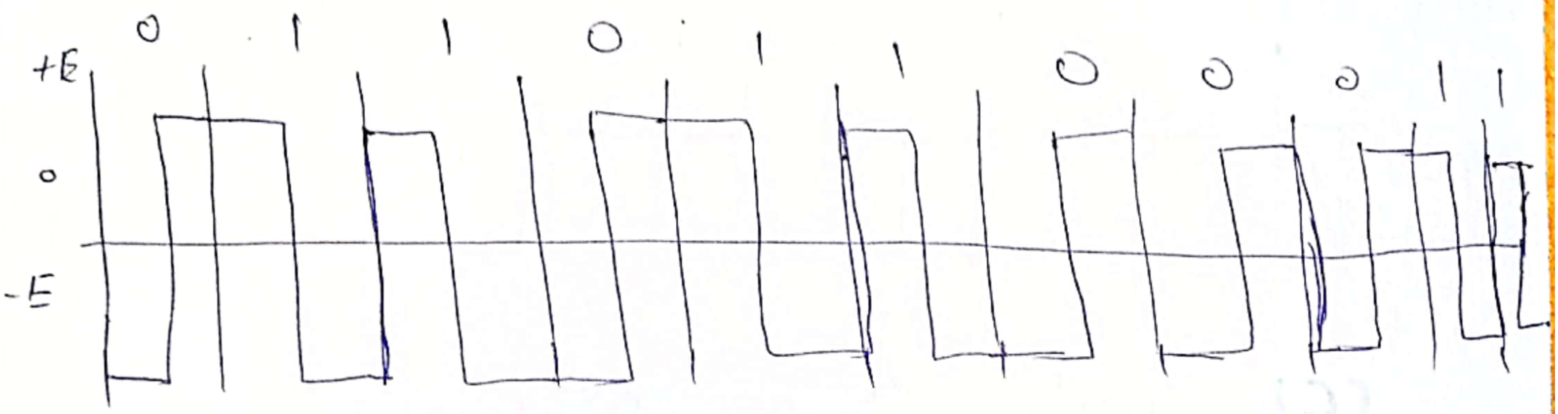
'0' for Low to high 1 for high to low.

Graph:



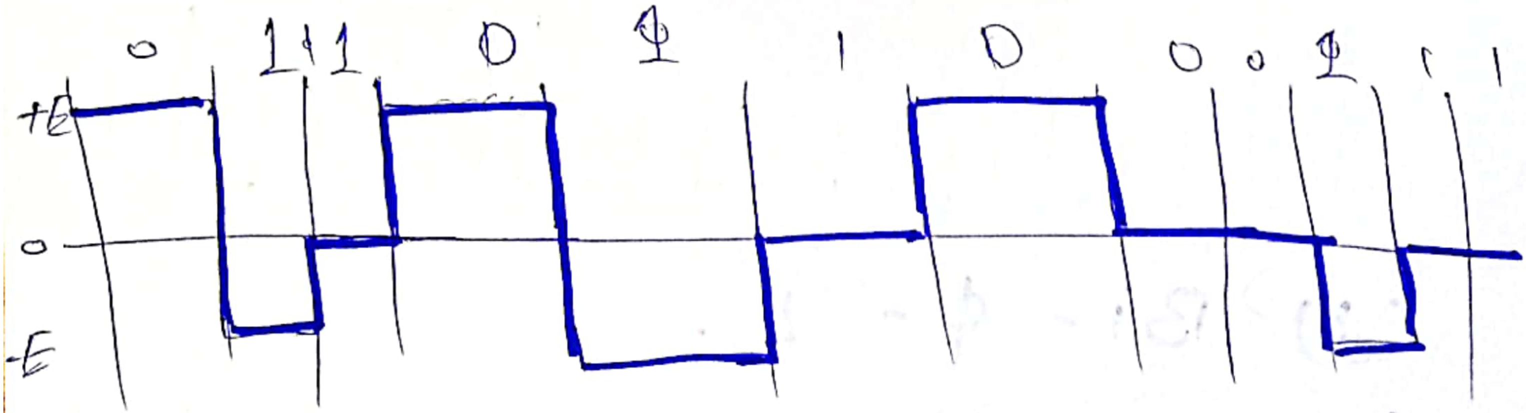
(d) Bi-Φ-L.

One is Represented by a 1 0 and Zero is represented by 0 1.



(e) Dicode NRZ.

A 'One' to zero or zero to one changes polarity. otherwise a zero is sent.



x ——— x

Q NO: 4

(a)

Carrier wave is $e_c(t) = 7.5 \sin 2\pi \times 10^3 \pi t$.

Modulation Index $= M_i = 0.5$

The General equation of Sine wave is

$C = A \sin(\omega t)$.

A is Amplitude of the wave.

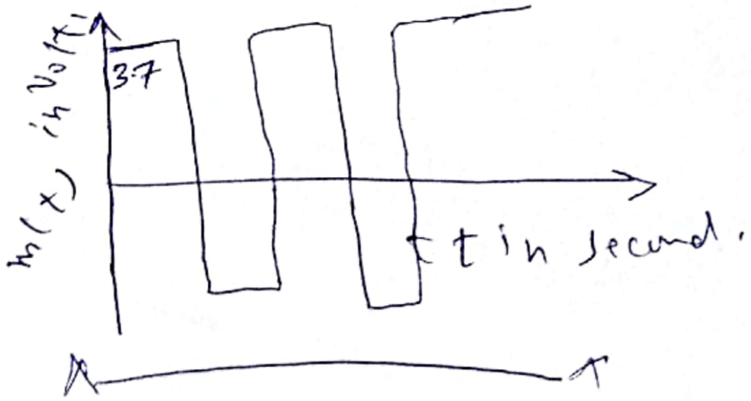
Comparing General equation of wave with give then Ac will be 7.5.

as we know that

$$m = MI = \frac{Am}{Ac}$$

$$Am = mi \times Ac = 0.5 \times 7.5$$

$$Am = 3.75$$



Q No: 4(b)

(a) Depth of Modulation:

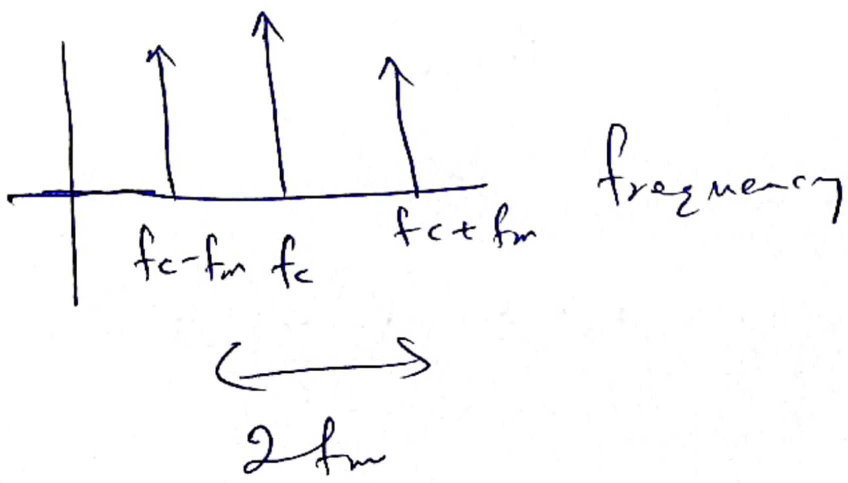
$$m = \frac{E_m}{E_c} = \frac{10\,V}{5\,V} = 2\,V$$

Transmission of feeiency = .

$$T_f = \frac{m^2}{2 + m^2} \Rightarrow \frac{(2)^2}{2 + (2)^2}$$

$$T_f = \frac{4}{6} = \frac{2}{3}$$

(b)



Amplitude frequency.

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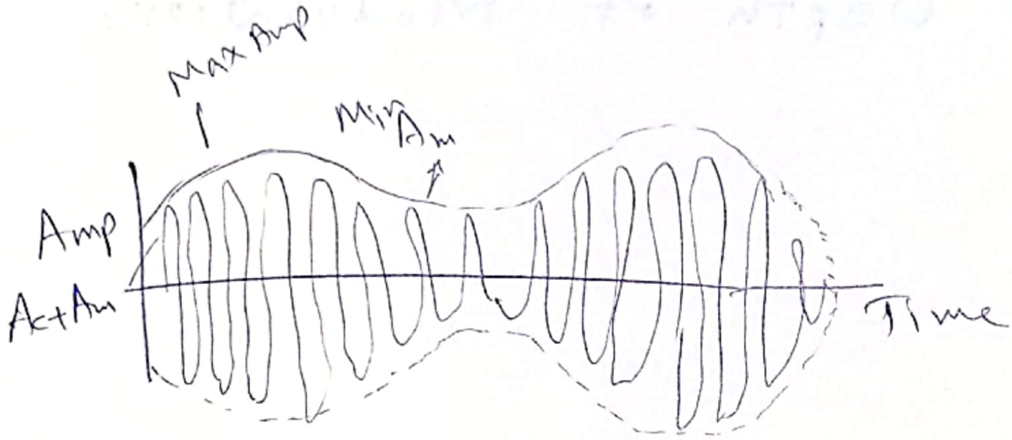

(C) Power in Spectrum.

$$P_c = \frac{E_c^2}{2 \times R} = \frac{(5)^2}{2 \times 50} = \frac{25}{100}$$

$$= \frac{1}{4}$$

and total Power $= P_t = P_t \left(1 + \frac{m^2}{2}\right) P_c$

$$= P_t \left(1 + \frac{(2)^2}{2}\right) 0.2$$

$$P_t = \left(1 + \frac{4}{2}\right) \times 0.2$$

$$P_t = 3 \times 0.2 = 0.6$$

(d) Percentage Power in USB.

$$P_{USB} = \frac{m^2 \times E_c^2}{8} = \frac{m^2}{4} P_c$$

$$= \frac{(2)^2}{4} \times 0.6$$

$$= 0.6$$

x ———————————— x