ID : 12595 Date: 29/09/2020

Q① A Signal (X) band limited by 250 HZ is Sampled by an impulse train angular frequency of f_s

ⓐ Determine the Nyquist rate required for perfect reconstruction of Signal.

Solution

Given Date

$f_m = 250H$, f_s

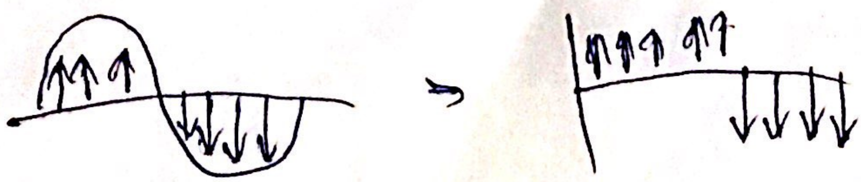
ⓐ Nquist rate

$N_p = 2 f_m$

$= 2 \times 250$

$= 500 HZ$

ⓑ



(c) Cut off frequency

$$f_c = \frac{1}{2\pi f_c R}$$

$$= \frac{1}{2 \times 3.14 \times 500}$$

$$= 0.0031$$

Q(1) (D) if The Frequency of Sampler is $fs = 800HZ$, draw The resulting Sampled Signal $S(f)$

Solution

$Fm = 250HZ$

$Fs = 800HZ$

As we know that

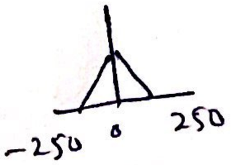
$fs = 2Fm$

So

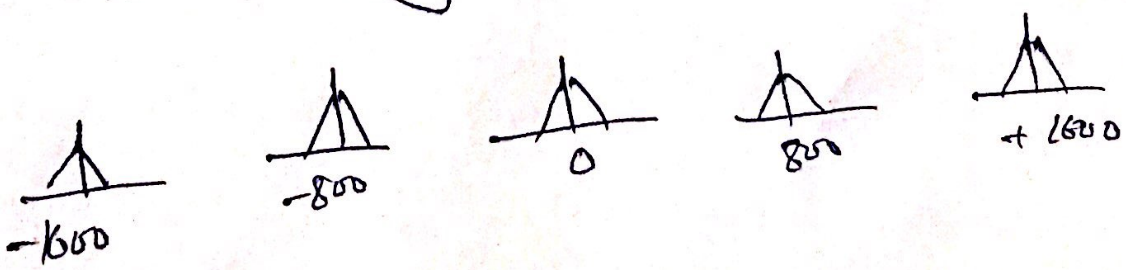
$800 = 2(250$

$800 = 500$

So $fs > fm$



The resulting Sampled Signal is



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Q2

(a) Let $x(t)$ be a Signal with Nyquist rate f_s determine the Nyquist rate for following:

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

Solution

~~Nyquist~~

$$m(t) = x(t) + x(t-1)$$

$$x(t) \rightarrow NR = \omega_s$$

$$m(t) = x(t) + x(t-1)$$

$$x(t) = \omega_s$$

$$x(t-1) = \omega_s$$

It is Same Because There is no effect of time Shifting on Nyquist rate

$$x(t) \xrightarrow{T.S} x(t-1)$$

Those two Signal have the Same Nyquist rate ω_s and to get the nyquist rate of $m(t)$ we need to Choose the nyquist rate which is max But both the nyquist rate of $x(t)$ & $x(t-1)$ are Same so by properties of nyquist rate of

$$m(t) = x(t) + x(t-1)$$

$$\downarrow \qquad \downarrow \qquad \downarrow$$

$$ws \qquad ws \qquad ws$$

The two nyquist rate are Same so directly the nyquist rate of $m(t)$ is ws Answer.

(2) $m(t) = \frac{dx(t)}{d(t)}$

So this time the massage signal is equal to 1 time derivative of signal $x(t)$ and we know the diffrenciation will not change the nyquist rate so if the original signal is

$x(t) = ws$

Then $\frac{dx}{dt} = ws$

$$m(t) = \frac{dx(t)}{dt}$$

$$\downarrow$$

$$ws = ws$$

Q 2 B

Given Data

$$m(t) = 10 \sin 400\pi t$$

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

$$f_m = \frac{\omega_m}{2\pi}$$

$$= \frac{400\pi}{2\pi}$$

$$f_m = 200 \ HZ$$

$f_s = 300 \ HZ$

$f_c = 150 \ HZ$

Required

what are the frequencies present in the reconstructed signal $y(t)$

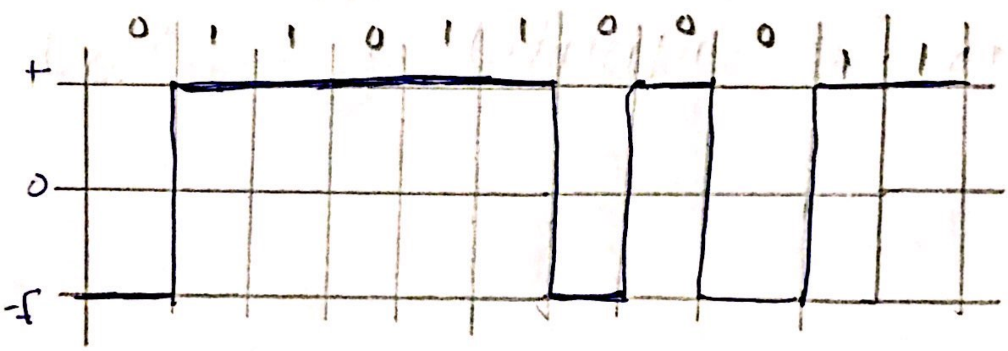
All frequencies are check and only -150 to $+150$ ranged frequencies are passed

So our answer is $100 \ HZ$

Q3 Consider the bit Sequence (01101100011) and draw the PCM waveform the following modulation schemes:

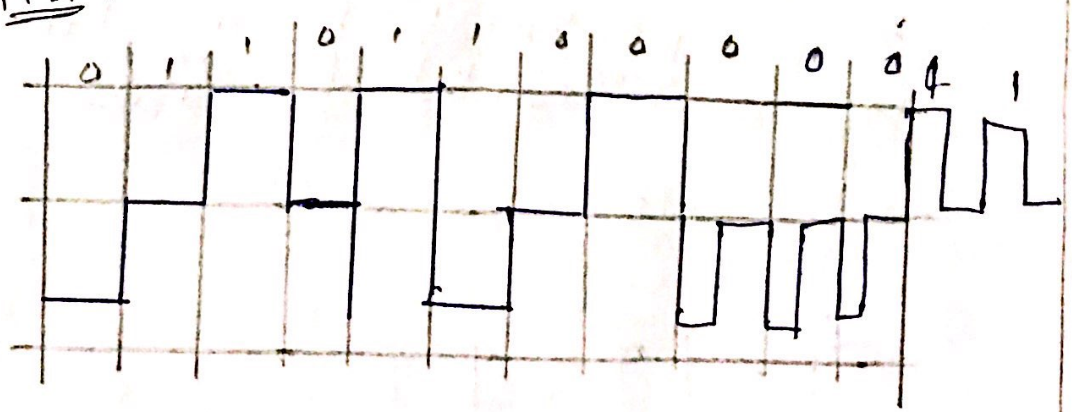
a) NRZ-S:

(01101100011)



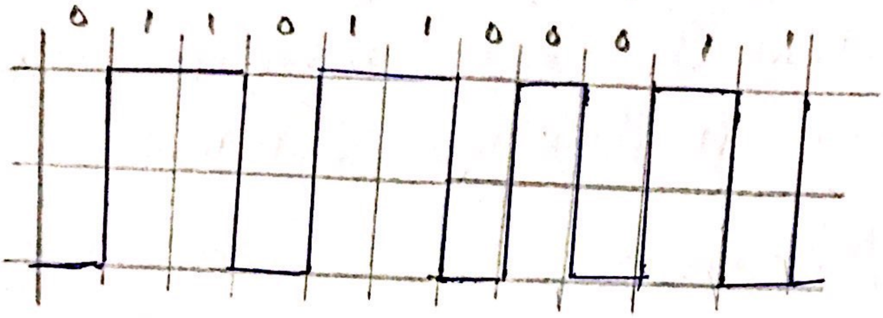
one is represented by a no change in level.
"Zero" is represented by a change in level.

b) Polar-RZ:



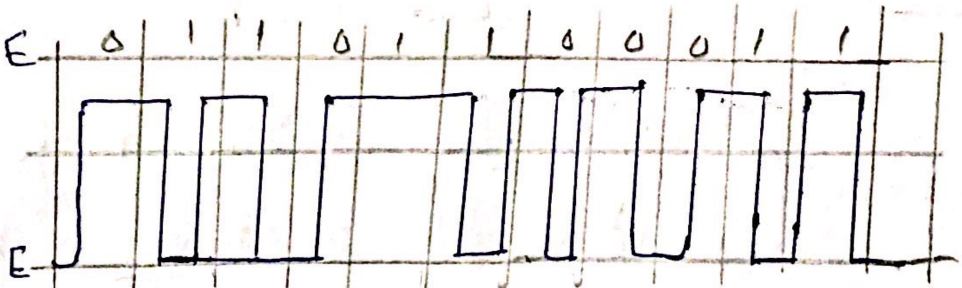
"One" and "Zero" are represented by opposite level Polar pulses that are one half-bit in width

c) Split Phase Manchester:



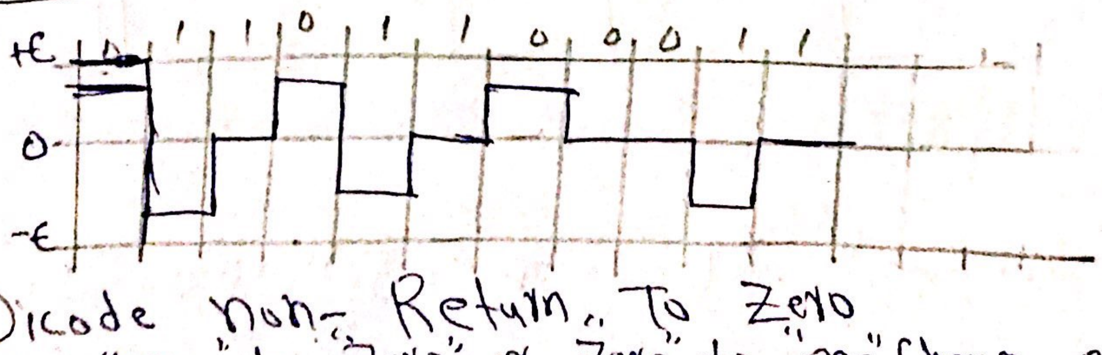
one is represented by a 1 0
Zero is represented by a 0 1

d) Bi-Φ-L



Bi-Φ-L (Bi phase level or split phase (1+180)
"one" is represented by a 10
"zero" is represented by a 01

e) Dicode NRZ:



Dicode non-Return To Zero
A "one" to "zero" or zero to "one" change polarity otherwise a "zero" is sent.

Q4 (a)

Solution

$m = 0.5$ $\quad$ $l_c = 7.5$ $\quad$ $E_c = 7.5$ volts

Let us consider E_m from E_c since

$$m = \frac{E_m}{E_c}$$

Therefore

$$E_m = m \times E_c$$
$$= 0.5 \times 7.5$$
$$= 3.75V.$$

$$E_{max} = E_c \times E_m$$
$$= 7.5 \times 3.75$$
$$= 11.250 \text{ Hz}$$

$$E_{min} = \frac{E_c - E_m}{7.5 - 3.75}$$
$$= 3.75 \text{ vo}$$

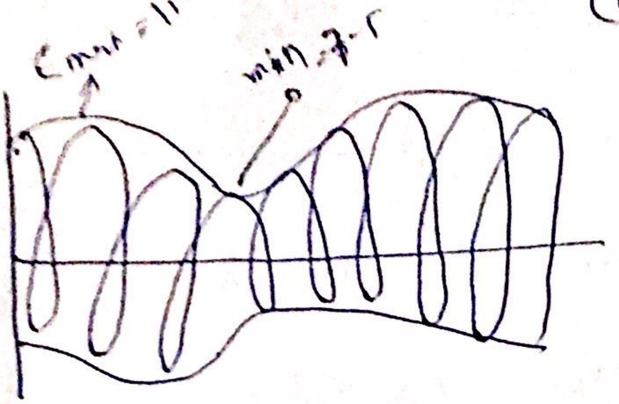
Modulated waveform

So As we know

$n = 0.5$

$E_{max} = 11.25$

$E_{min} = 3.75$



b Q4

Solution

Depth of modulation

$$m = \frac{E_m}{E_c}$$

$$m = \frac{10V}{5V} = 2V$$

Tranmission efficency

$$tf = \frac{m^2}{2+m^2}$$

$$tf = \frac{(2)^2}{2+(2)^2}$$

$$tf = \frac{4}{2+4} = \frac{4}{6} = 2/3$$

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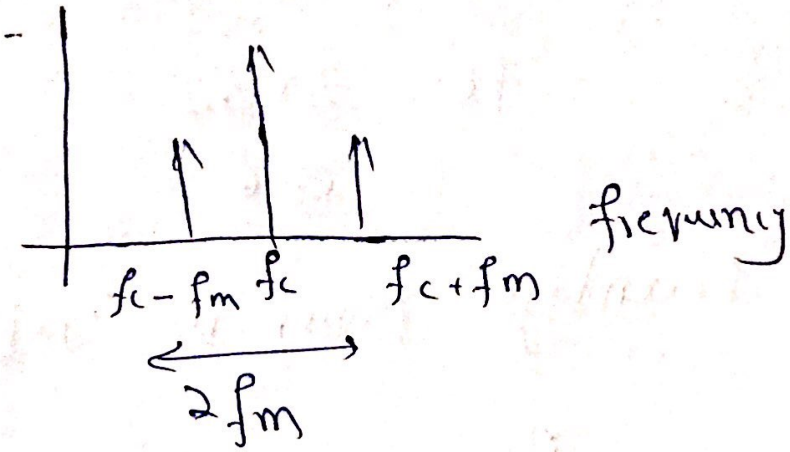
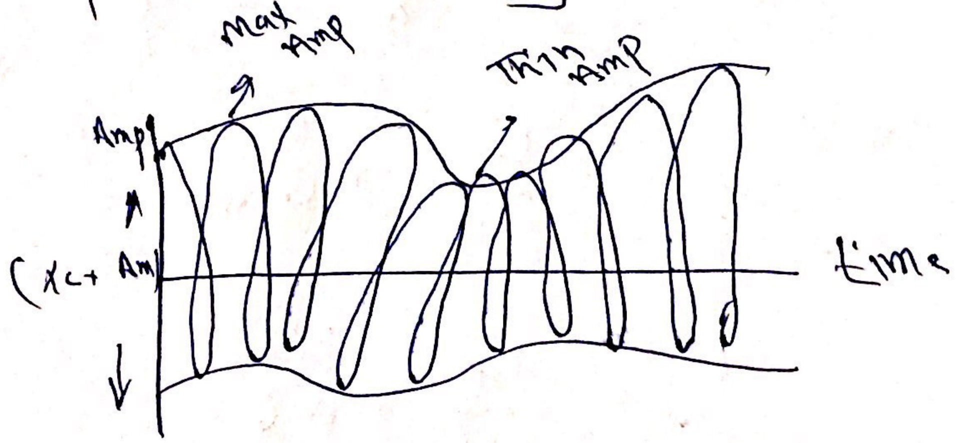
(11)

(b)



Amplitude frequency



(c) Power in Spectrums

$$P_c = \frac{E_c^2}{2 \times R} = \frac{(5)^2}{2 \times 50} = \frac{2}{100} = 1/4$$

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

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

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

$$Pt = (1+2) \times 0.2$$

$$Pt = 3 \times 0.2$$

$$= 0.6$$

(d) Pecentage Power in USB

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

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

$$= \frac{\cancel{4}}{\cancel{4}} \times 0.6$$

$$= 0.6 = 60\%$$