Name = Talha Khan
ID = 13845
Instructor = Sir Sohail Imran
Subject = Communication System

Q (1):

(a) Signal $x(t)$

$f_m = 250\,Hz$

angular frequency $= f_s$

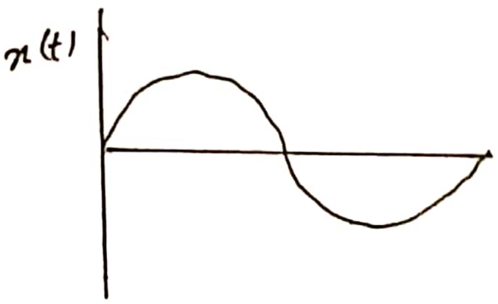
Nyquist rate =

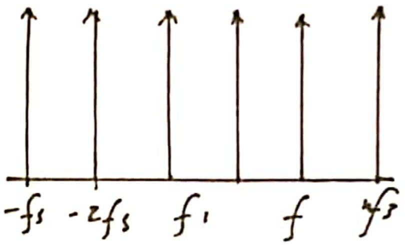
$NR = ?$

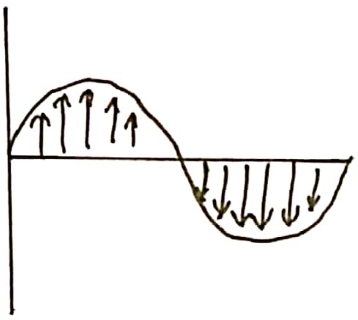
$NR = 2f_m$

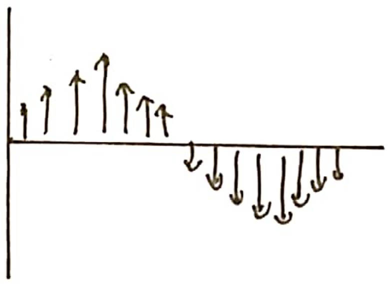
$= 2 \times 250 = 500\,HZ$

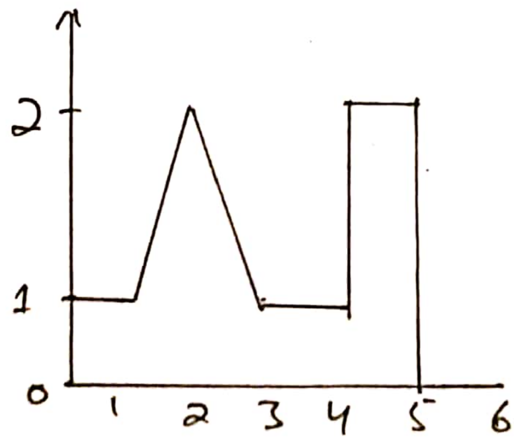
(b)











$x(t) = u(t) + r(t-1) - 2r(t-2) + r(t-3) + u(t-4)$
$- 2u(t-5)$

$x(2) = u(2) + r(1) - 2r(0) + r(-1) + u(-2)$
$- 2u(-3)$

$= 1 + 1 = 2$

$x(5) = u(5) + r(4) - 2r(3) + r(2) + u(1)$
$- 2u(0)$

$= -1 + 4 - 2 - 3 + 2 + 2 + 1 - 21$

$= 36$

(c) cutt off freq

$$f_c = \frac{1}{2\pi c R} = \frac{1}{2 \times 3.14 \times 500}$$

$$f_c = \frac{1}{31000} = 302 \times 10^{-6} \text{ Hz}$$

Q 1:

(d) Sol:-

$F_m = 250 Hz$

$F_s = 800 Hz$

As we know that

$F_s = 2F_m$

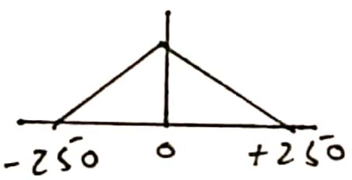
So

$800 = 2(250)$

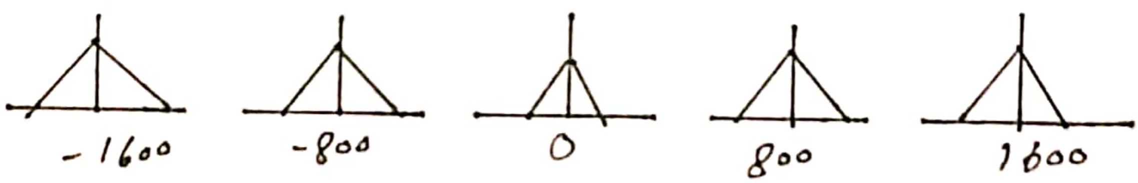
$800 = 500$

So

$F_s > F_m$



The sampled signal is



Q(2):

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

Sol:-
Nyquist rate = 2 × maximum signal frequency. Sampling Rate must exceed Nyquist rate in order to be able to fully reconstruct the signal.

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

Fourier transform $Y(jw) = X(jw) + e^{-jw} X(jw)$

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

(ii) $y(t) = \dfrac{dx(t)}{dt}$

Fourier transform ⇒ $Y(jw) = jw\, X(jw)$

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

Q(2):

(b) message sampled $m(t) = 10\sin 400\pi t$.

$f_s = 300$ HZ.

cut-off frequency $= 150$ HZ $= f_c$

the frequency/frequencies present in the reconstructed signal $y(t)$.

Sol:- $m(t) = 10\sin 400\pi t$

So $w_m = 400\pi$ rad/sec

$f_m = \frac{w_m}{2\pi} = \frac{400\pi}{2\pi} = 200$ HZ.

frequency constructed of $y(t) =$

1st we calculated sample frequency by formula. $nf_s \pm f_m$

put different value of n

$n=0 \Rightarrow f_s \pm f_m = 0 \pm f_m = \pm f_m = \pm 200$ HZ

$n=1$

$\Rightarrow fs \pm fm = 1fs \pm fm = $ $\begin{cases} 1fs + fm = 300 + 200 = 500\ Hz \\ 1fs - fm = 300 - 200 = 100\ Hz \end{cases}$

$n=-1$

$= fs \pm fm = -fs + fm = -300 + 200 = -100\ HZ$

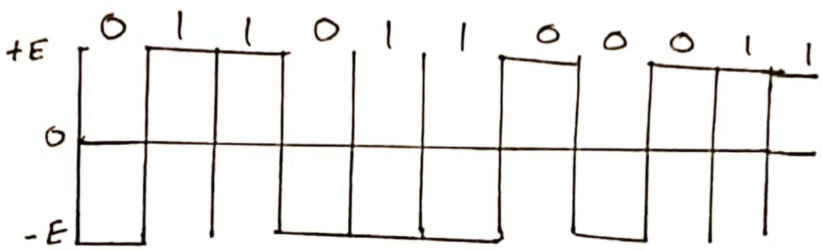
$fs - fm = -300 - 200 = -500\ HZ$

the cut-off frequency is 150 so the frequency Rang from -150 Hz to +150HZ will pass into output.

So frequency 100HZ and -100HZ is an rang. So 100HZ will be component of output.

Q (3)

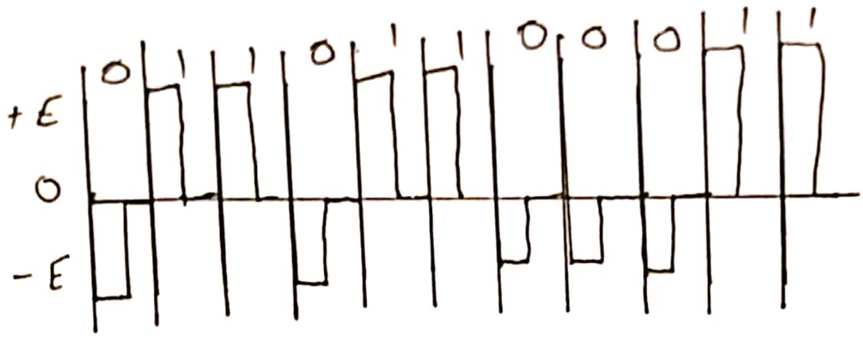
(1) NRZ-S:



* 'One' is Represented by No change in level.
* 'Zero' is Represented by change in level.

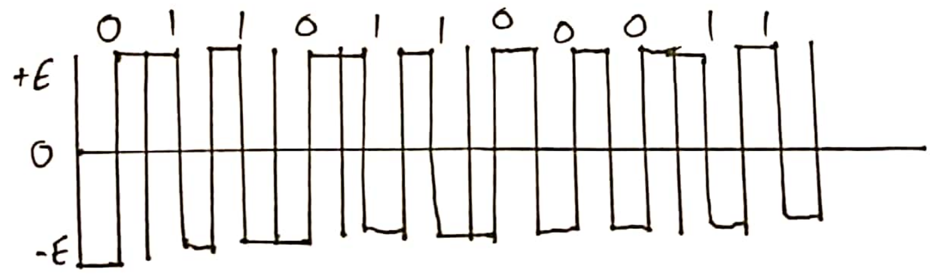
(b) Polar-RZ:

One and zero are Represented by opposite level pulses that are one half bit in width.



(c) Split Phase Manchester:

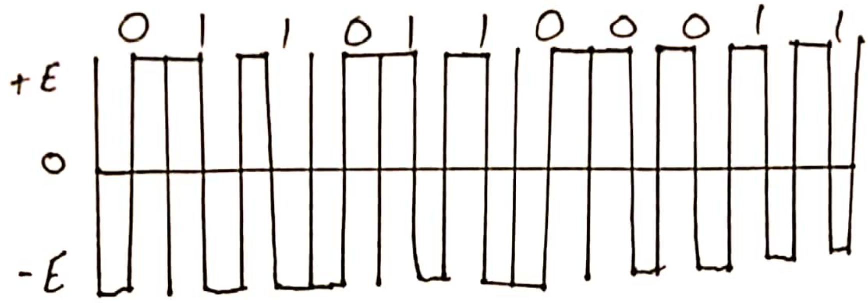
'0' for Low to High and '1' for high to Low.



(d) Bi-ϕ-L:

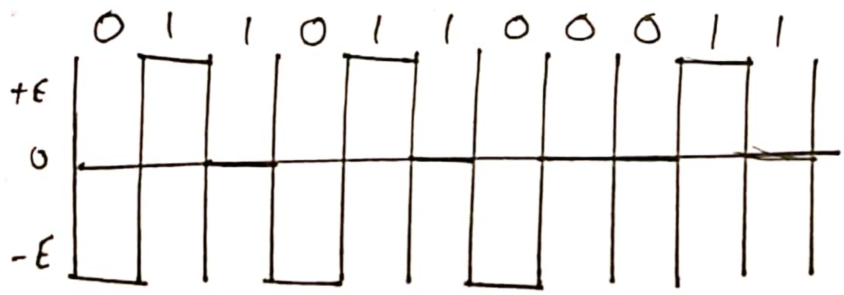
'one' is represented by a 10.

'zero' is represented by a 01.



(e) Dicode-NRZ:

A one to zero or zero to one changes polarity otherwise or zero is sent.



Q 4:

(a) Given:

$e_c(t) = 7.5 \sin 20 \times 10^3 \pi t$

$E_c = 7.5$ volts

mod index = 0.5

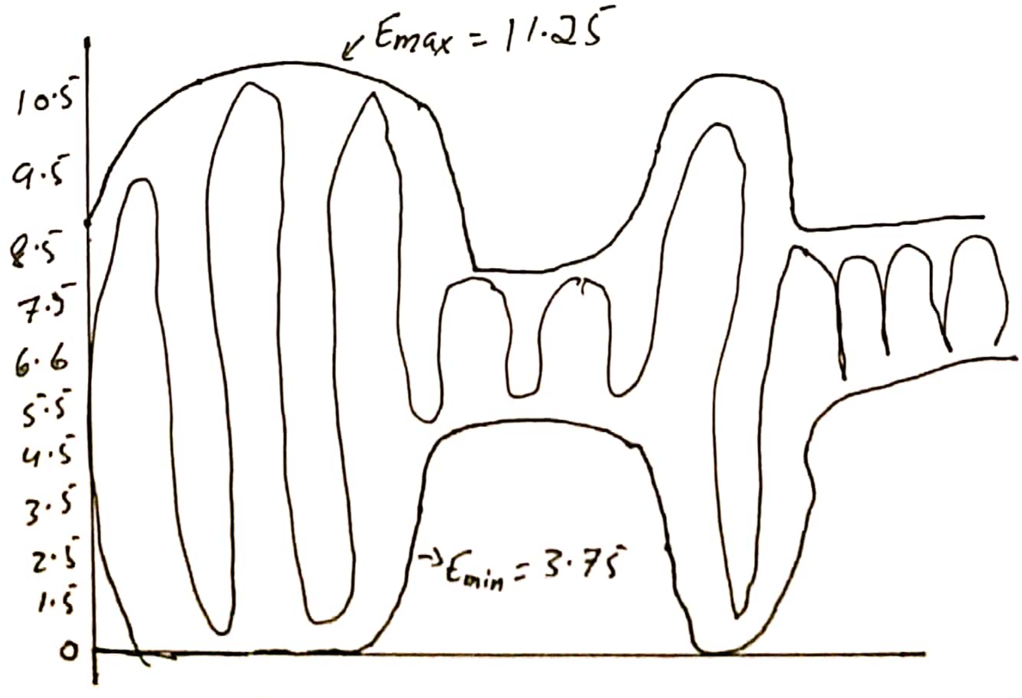
Sol:- Let us calculated E_m from E_c since

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

$E_m = m \times E_c = 0.5 \times 7.5 = 3.75$ volt

$E_{max} = E_c + E_m = 7.5 + 3.75 = 11.25$ volt

$E_{min} = E_c - E_m = 7.5 - 3.75 = 3.75$ volt



Q 4: (b)

(a) Depth of modulation:-

$$m = \frac{Em}{Ec}$$

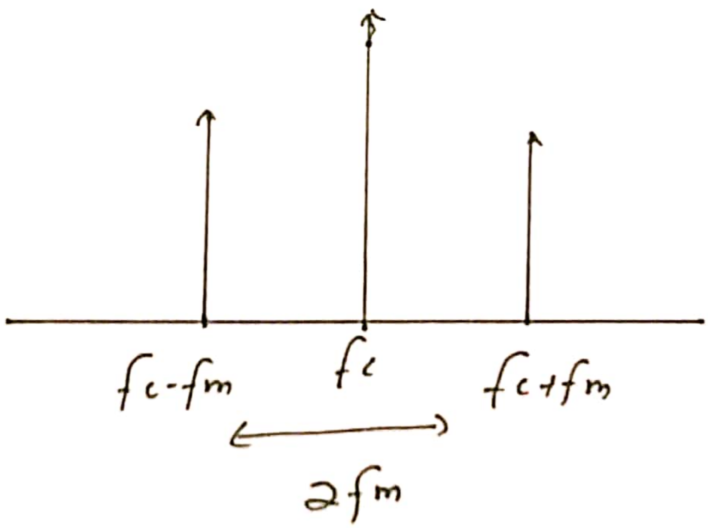
$$m = \frac{10V}{5V} = 2V$$

transmission efficiency:

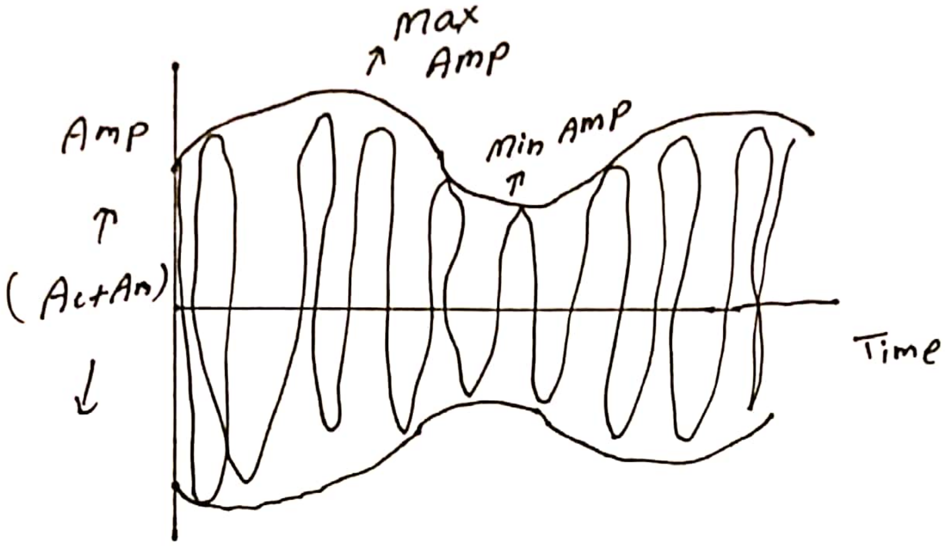
$$tf = \frac{m^2}{2 + m^2} \Rightarrow \frac{(2)^2}{2 + (2)^2}$$

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

(b).



Amplitude frequency:



(C) Power in spectrum:

$$P_c = \frac{E_c^2}{2 \times R} = \frac{(5)^2}{2 \times 50} = \frac{25}{100} = \frac{1}{4}$$

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

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

$$P_t = (1+2)\,0.2 \Rightarrow P_t = 3 \times 0.2 = 0.6$$

(d) Percentage power in USB:

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

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

$$= 0.6\%$$