Q1. (1)

(1)

• ~~Bit rate~~ =

(Hd)

• Bit length of data = 16 bit

$\Rightarrow$ total bits produced by our sensor in 1 second

$= 10\times10^3 (16) = 1.6\times10^5$ bits/second

$\Rightarrow$ as the error code is (7,4) means out of every 7 bits four are of use and 3 are for accounting noise

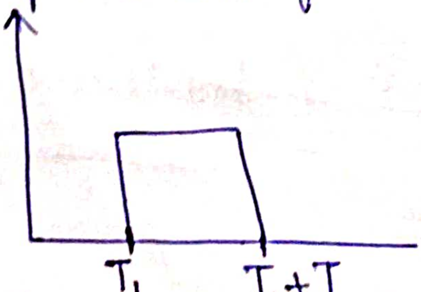
$\therefore$ readable data $= 1.6\times10^5 \times 4/7 = 91428.57 \approx 91429$ bits/second

now as there are 15 sensor total bits

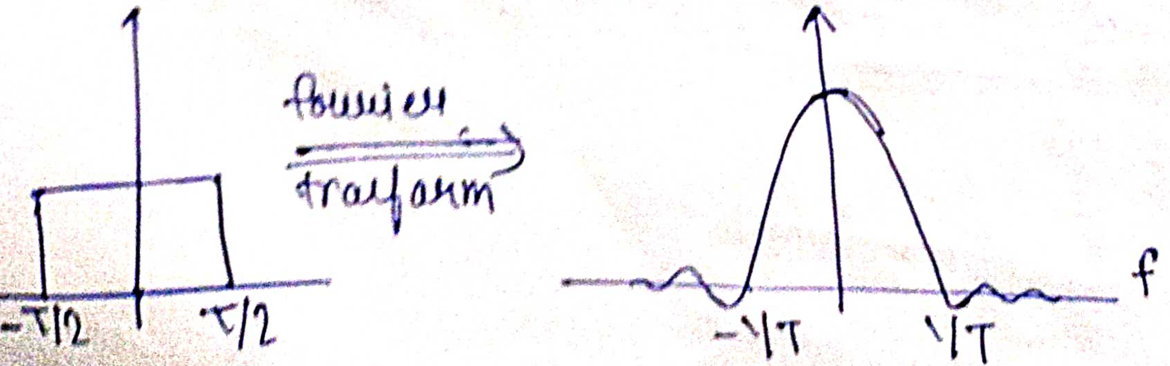
= out data rate $= 1371428.57$ bits/sec

$= 1.37$ Mbps

Now lets say we transfer a bit of data in time $= T$ i.e

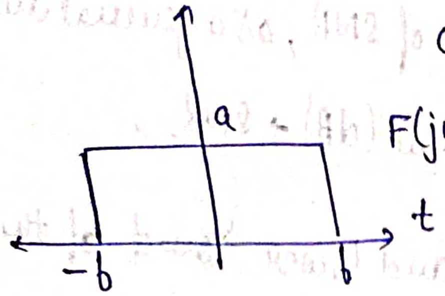


This being a rectangular f^n in time domain will be a sinc f^n in the frequency domain.



(shifted to origin for simplicity)

(2)



Calculating FT for this system we do

$$F(j\omega) = \int_{-b}^{b} a e^{-j\omega t} dt = a\int_{-b}^{b} e^{-j\omega t} dt$$

$$= \left.\frac{a e^{-j\omega t}}{-j\omega}\right|_{-b}^{b}$$

$$= -\frac{a}{j\omega}\left[e^{-j\omega b} - e^{+j\omega b}\right]$$

$$= \frac{2a}{j\omega}\left(\cancel{j}\sin(\omega b)\right)$$

$$= \frac{2ab\sin(b\omega)}{\omega b} = 2ab\,\mathrm{sinc}(\omega b)$$

comparing it with the previous analysis, the eq^n for one bit in freq. domain'll be

$$2(1)(T/2)\,\mathrm{sinc}(\omega T/2) = T\,\mathrm{sinc}(\omega T/2)$$

now ω at which it'll be 0 for first time

$$\Rightarrow \sin(\omega T/2) = 0$$

$$\Rightarrow \frac{\omega T}{2} = n\pi \Rightarrow \omega = 2n\pi/T$$

$$n=1 \Rightarrow \omega = 2\pi/T$$

$$\therefore f = \omega/2\pi = 1/T$$

$\therefore$ the bandwidth $= 2/T$

now data rate $= 1/T$ bps

$\therefore$ bandwidth $= 2\times$ data rate

$\therefore$ our required bandwidth $= 2\times 1.37$ Mbps

$= 2.74$ MHz

Now given channel bandwidth $= 2$ GHz which is much above than the found bandwidth and thus the found bandwidth is valid $\therefore$ Final answer $= 2.74$ MHz.