INDEX

S.No.	Experiment Name	Page No.	Experiment Date	Submission Date	Teacher's Sign/ Remarks
1.	To Understand the path loss.	01 to 02	10/10/23	17/10/23	
2.	Understand the path loss with shadowing	03 to 05	17/10/23	7/11/23	
3.	Understanding the Flat fading.	06 to 08	7/11/23	20/11/23	
4.	Understanding the frequency selective fading.	08 to 09	20/11/23	5/12/23	
5.	Understanding the multipath Channel for the following objectives.	10 to 13	5/12/23	12/12/23	
6.	Perform following Experiment Using CDMA trainer kit. 1. PSK modulation and Demodulation 2. Bit synchronization extraction.	13 to 17	12/12/23	15/12/23	

Experiment No:- 1

Aim: To understand the path loss.

Theory: Path loss (PL) refers to the loss or attenuation a propagating electromagnetic signal encounters along its path transmitter to the receiver.

As a result of path loss, the received signal power level is several orders below the transmitted power level. The received power level is dependent on factors such as transmission power, antenna gains, frequency of operation and the receive like any other gain or attenuation path loss is also expressed in decibel (dB). We can relate the received power level and the path loss but before that let's know the experession of path loss

Definition of path loss mathematically

The path loss is expressed mathematically as

$$PL(dB) = 20 \log_{10}\left(\frac{4\pi d}{\lambda}\right) \quad \text{------ (1)}$$

d is the distance between the transmitter and receiver and receives and λ is the wavelength of the signal.

As said earlier, the received power level depends on the path loss. The expression for the received power at a distance 'd' the transmitter is expressed mathematically using transmission equation as

$$P_r = P_t G_t G_r \left(\frac{\lambda}{4\pi d}\right)^2 \quad \text{------ (2)}$$

By definition, path loss is the ratio of the transmitted power to the received power from the above equation, we can get radio of P_t and P_r

$$\frac{P_t}{P_r} = \frac{1}{G_t + G_r \left(\frac{\lambda}{4\pi d}\right)^2}$$

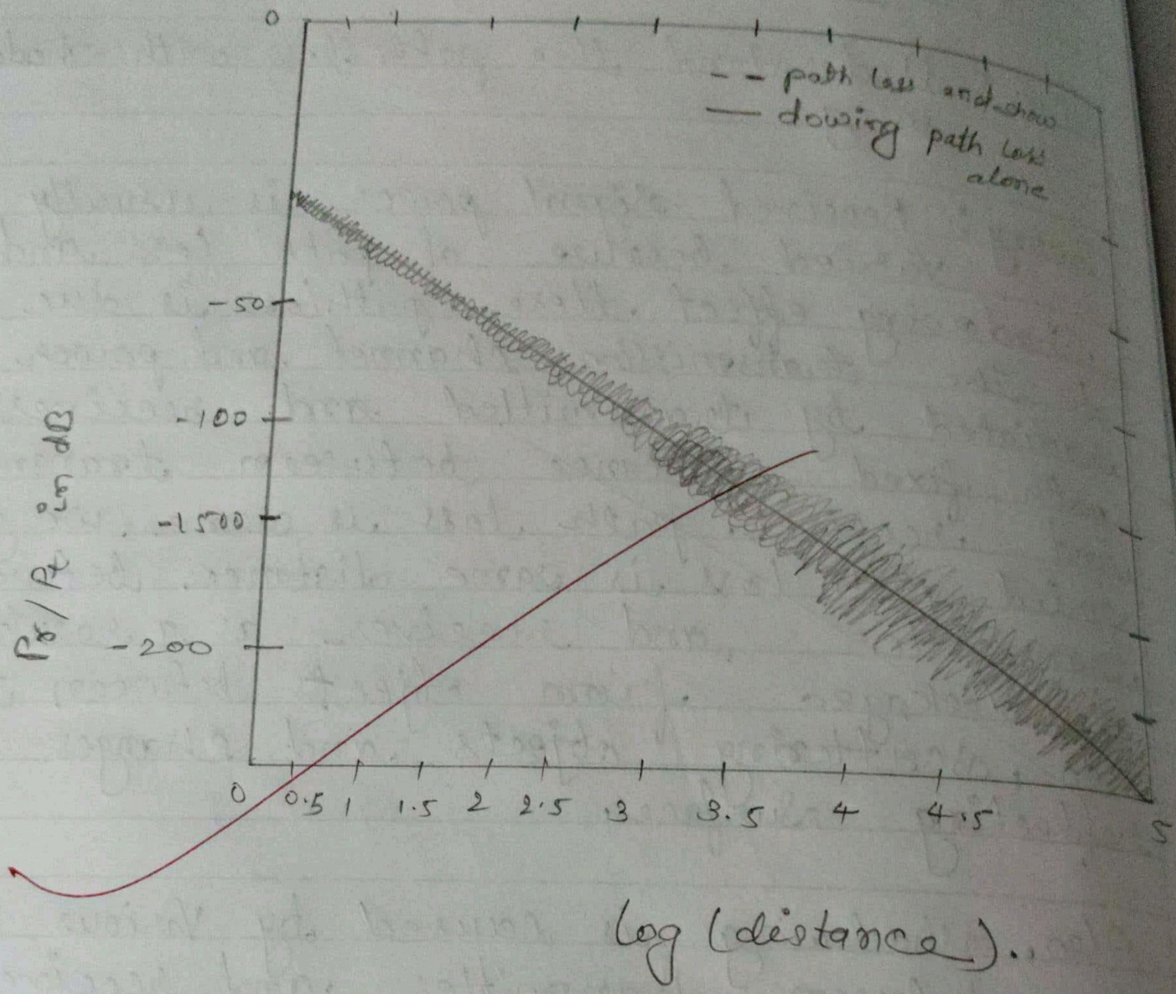
Experiment No :- 2

Aim : Understand the path loss with shadowing.

Theory : Received signal power is usually varied because of path loss and Shadowing effect. Here, pathloss is due to the transmission channel and power radiated by transmitted and receiver, path fixed distance between transmitter and receiver, path loss is same. we get varied path loss is same distance between transmitter and receiver as a result of blockages from objects between the two, scattering objects and changes in reflecting surfaces.

Also, shadowing is caused by various obstacles between transmitter and receiver

Typically, models for path loss and Shadowing are superimposed on each other in order to characterize the power falloff Vs. distance along with the random



Result: Combine path loss and shadowing.

attenuation occurred due to this path loss from shadowing. for this combined model, average path loss $\mu \psi$ dB is characterized the by path loss model while shadow fading generated variations about this mean.

$$\frac{P_r}{P_t}(dB) = 10\log_{10}K = 10\gamma\log_{10}\frac{d}{d_0} \mp \psi dB$$

Here, ψ dB = Gaus distributed random variable with zero mean and variance = $\sigma^2 \psi dB$ - outage probability: For wireless systems to be acceptable, received signal power should always be $\geq P_{min}$ outage probability can be defined as:

$$p(P_r(d) \leq P_{min}) = 1\,P_{min} - \frac{(P_t + 10\log 10\,K - Q - 10\gamma\log_{10}\frac{d}{d_0})}{\sigma \psi dB}$$

Here, Q function is the probability that a random variable x with zero mean and variance > Z.

$$Q(x) = p(x > Z) = \int_Z^\infty \frac{1}{\sqrt{2\pi}} \cdot e^{\frac{x^2}{2}} dy\, Q$$

function and complementary error function can be converted each other with following equation

$$Q(z) = \frac{1}{2} \, erfc\left(\frac{z}{\sqrt{2}}\right)$$

Experiment No : 3

Aim: Understanding the flat fading.

Theory: If the mobile radio channel has a constant gain and linear phase response over a bandwith which is greater than the bandwidth of the transmitted signal, then received signal will undergo flat fading.

This type of fading is the most common type of fading, the multipath structure of the channel is such that the spectral characterstics of the transmitted signal are preserved at the receiver. The response of a flat fading channel for a pulse of duration Ts is illustrated in fig.

It can be seen from figure, that if the channel gain changes over time, a change of amplitude occurs in the received s/g over time the received signal r(t) varies in gain but the spectrum of the transmission is preserved. The delay spread I

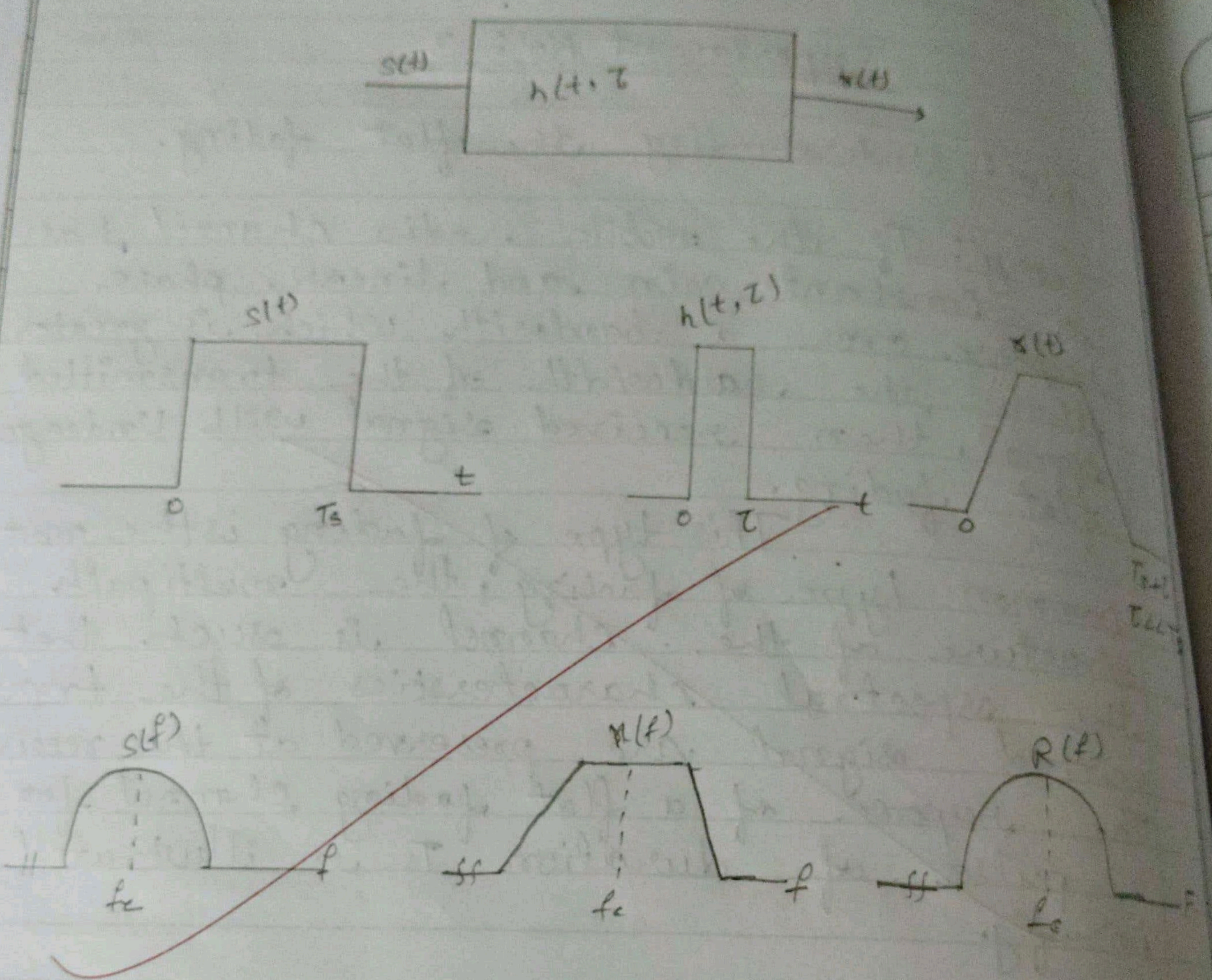


fig: Response of a flat fading channel.

introduced by the symbol much smaller than the symbol period Ts. Hence the total symbol is received in an interval of Ts + Y which is received is an similar to the transmitted symbol. Hence chances of intersymbol interfrence is minimum. Similarly the signal spectrum s(f) is much smaller than the coherence band width of the channel. Hence on the receiver side of the signal spectrum is understo reted.

Flat fading channels are also known as amplitude varrying channels and are some times referred to as narrowband channels since the bandwidth of the applied signal is narrow as compared to the channel flat fading fades, and thus may require 20 or 30dB more transmitter power to archive low bit error rates during times of deep fades as compared to systems operating over non-fading channels. The distribution of the instanteneous gain of flat fading channels is important for desiging radio links and the most common amplitude distribution is the Ray-leigh distributions.

Experiment No: 4

Aim: Understanding the frequency selective fading.

Theory: Frequency selective fading It the channel possesses a constant gain and linear phase response over a bandwidth of that is smaller than the channel creates frequency selective fading on the received signal.

Under such conditions the channel impulse response has a multipath delay spread which is greater than the reciprocal bandwidth of the transmitted message waveform. When this occurs, the received signal includes multiple versions of the transmitted waveform which are attenuated and delayed in the time, and here the received signal is distorted. Frequency selective fading is due to time dispersion of the transmitted symbols within the channel.

Thus the channel includes intersymbol interference (ISI).

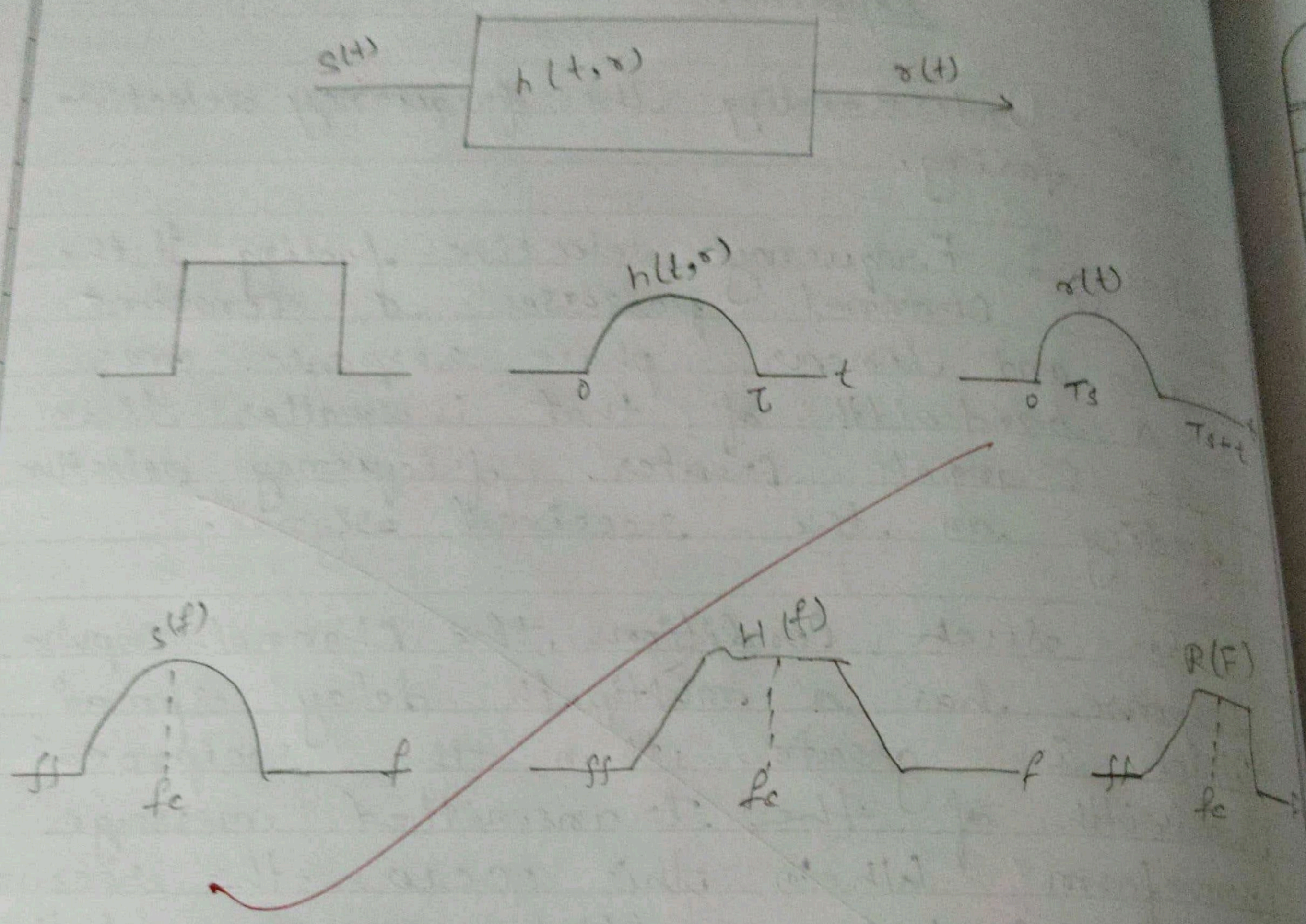


fig: Response of a frequency selective fading Channel.

frequency selective fading channels are much more difficult to model than flat fading channels since each multipath signals must be considered to be a linear filters. Summarizing, the following two conditions should be true:

$$B_s > B_c$$

$$T_s < T_T$$

Experiment No: 5

Aim: Understanding the multipath channel for the following objectives.

1. No fading
2. Flat Fading
3. Dispersive fading.

Theory: Multipath Fading is a feature that needs to be taken into account when designing or developing a radio communication system, the s/g will be reach the receiver not only via the direct path, but also as a result of reflections from objects such as buildings, hills, ground, water etc. that are adjacent to the main path.

The overall signal at the radio receiver is a summantation of the variety of signals being received. As they all have different path length, the signals will add and substract from the total dependant upon their relative phases.

At times there will be changes in the relative path length. This could result from either the radio transmitter or receiver moving or any of the objects

that provides a reflective surface moving This will result in the phases of the signals arriving at the receiver changing, and in turn this will result in the signal strength varrying as a result of the different way in which the signals will sum together. It is this that causes the fading that the present on many signals.

* Flat Fading *

This form of multipath fading affects all the frequency across a given channel either equally or almost equally channel either path fading is experienced the signal will just change in amplitude, rising and falling over a period of time or with movement from one position to another.

* Dispersive Fading Models *

Dispersive fading models with several echoes each exposed to different delay, gain and phase shift, often constant. This results in frequency selective fading and inter symbol interference. The gains may be Rayleigh of Rician distributed. The echoes may also be exposed to doppler shift, resulting in a time varrying channels model.

Experiment No : 6

Aim : Perform following experiments using CDMA trainer kit.

1. PSK modulation and demodulation experiment
2. Bit synchronization extraction experiment.
3. Error correction encoding experiment.

1. PSK Modulation and Demodulation

Hardware required:

PSK Trainer kit - AET-71
Dual Trace oscilloscope - POS - 2020
Digital Multimeter.

Introduction:

Phase shift keying is a modulation/ data transmitting technique in which phase of the carrier signal is shifted between two distinct level. In a simple PSK Unshifted Carrier $V\cos w_0 t$ is transmitted to indicate a 1 condition and the carrier shifted by 180° i.e - $V\cos w_0 t$ is transmitted to indicate as 0

Condition.

PSK Modulator :

Figure 1, shows the PSK modulator IC CD 4052 is a channel analog multiplexer and is used as an active component in this circuit. One of the control signals of 4052 is grounded so that 4052 will act as a two channel multiplexer and other control is being connection to the binary signals i.e data to be transmitted unshifted carrier signal is connection directly to CH1 and carrier shifted by 180° is connected to CH2 phase shift Network is a unity gain inverting amplifier using op-amp (TL051).

PSK Demodulator :

Demodulation of PSK is achived by subtracting the received carrier form a derived synchronous refrence carrier of constant phase figure shows the simple coherent PSK demodulator.

Procedure :

1. Connect the trainer to mains and switch on the power supply
2. Measure the output of the regulated power supply i.e +5v and -5v with the help of digital multimeter.
3. observe the output of the carrier generator using CRO, it should be an a 8KHz sine with 5vpp amplitude.
4. Observe the various data signals using CRO.

Modulation :

5. Connect carrier signal to carrier input of the PSK modulator.
6. Connect data signal say 4KHz from data source to data input of the modulator.

7. Keep CRO in dual model and connect CH1 input of the CRO to data signal and CH2 to the output of the PSK modulator.

8. Observe the PSK output signal with respect to data signal and plot the waveform.

Demodulations:

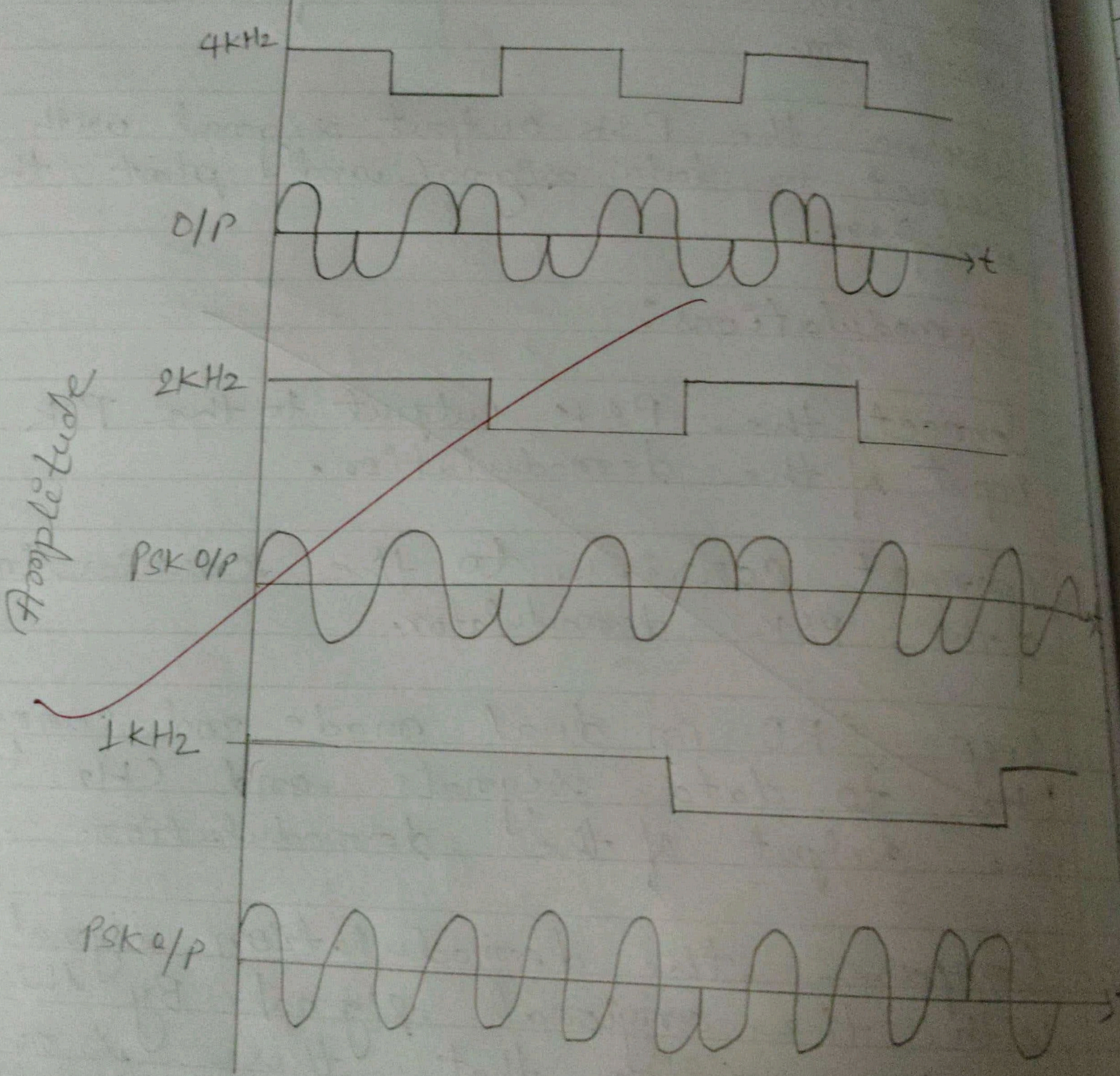
9. Connect the PSK output to the PSK input of the demodulation.

10. Connect carrier to the carrier input of the PSK demodulator.

11. Keep CRO in dual made and connect CH1 to data signals and CH2 to the output of the demodulation.

12. Compare the demodulation signal with the origional signal By this we can notice that there is no class in modulation and demodulation

MODEL GRAPH:



Process.

13) Repeat the steps 6 to 12 with different data signals i.e 2 KHz and 1 KHz.

Result:

Thus the PSK modulation and demodulation were performed and graphs were plotted.