1. (10%) (1).If one of two waveforms

$$s_1(t) = \cos 2\pi f_c t \qquad 0 \le t \le T_b$$
$$s_2(t) = -\cos 2\pi f_c t$$

is transmitted in each interval, what type of modulation is used in the digital communication system? (5%)

(2).Write the phase state in radians of the DPSK signal in response to the binary sequence 10010011 if the reference bit is 1. (5%)

2. (10%) Down link budget of a digital communication system is analyzed. If the transmitted power P_t=10dBW, transmitter antenna gain G_t=20dB; receiver antenna gain G_r=20dB; the free space loss L=106dB, equivalent noise temperature T_e= 100^0K and the Boltzmann constant=-228dBW/^{0}K-Hz. (1). Please determine the signal to noise power density ratio (P_r/N_0) of the receiver. (5%) (2) Determine the bit energy to noise power density ratio (E_b/N_0) if bit duration is 10^{-5} sec. (5%)

3.(10%) Figure 1 shows a pair of signals $s_1(t)$, $s_2(t)$.

(1).Prove that the signals $s_1(t)$ and $s_2(t)$ are orthogonal. (5%)

(2).Construct the signal constellation for $s_1(t)$ and $s_2(t)$. (5%)

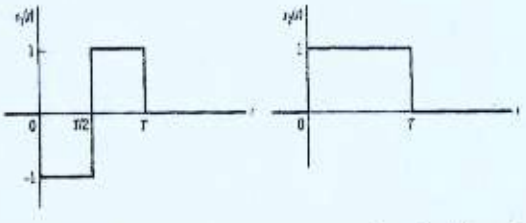

Fig. 1

4. (10%) The geometric representation is illustrated in Fig. 2 for the case of a two-dimensional signal space with two signals $\vec{s}_1$ and $\vec{s}_2$, that is, N=2 and M=2. Using the maximum likelihood rule to determine the transmit signal if the received signal is $\vec{x}$.

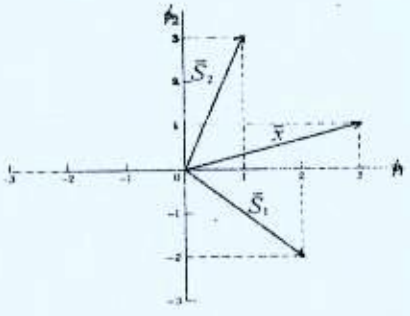

Fig. 2

5.(20%) A PCM system uses a uniform quantizer followed by a 5 bit binary encoder. The bit rate of the system is equal to $50*10^6$ *bits/sec*.

(1)Please draw the block diagram of PCM transceiver. (10%)

(2)What is the maximum message bandwidth for which system operates satisfactorily? (10%)

6.(20%) A zero mean white Gaussian noise w(t) with the power spectral density $S_w(f)= N_0/2$ is applied to an ideal bandpass filter with frequency response , as shown in Fig.3.

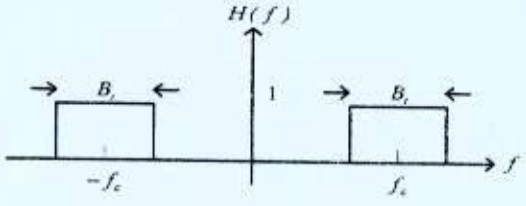

Fig.3 Frequency response of ideal bandpass filter

The transmission bandwidth $B_t=2W$ Hz, W is the bandwidth of m(t).The output n(t) of band pass filter is the narrowband noise signal . $n(t)=n_I(t)\cos 2\pi f_c t - n_Q \sin 2\pi f_c t$.

(1) Draw the power spectral density $S_n(f)$ of n(t) and write it's formula. (5%)

(2) If $r(t)= \sqrt{n_I^2(t)+n_Q^2(t)}$, $\Psi(t) = \tan^{-1}\frac{n_Q(t)}{n_I(t)}$, and $n(t_i)$, $n_I(t_i)$, $n_Q(t_i)$ are Gaussian random variable, what are the types of random variables $r(t_i)$ and $\psi(t_i)$?(5%)

(3) Determine the average power of n(t). (5%)

(4) Draw the power spectral density of $n_I(t)$ and $n_Q(t)$ and determine the average power of $n_I(t)$ and $n_Q(t)$. (5%)

7. (20%) The minimum distance $d_{min}=3$ for a Hamming code (7,4). (1). Please use the generator polynomial $g(x) = 1 + x + x^3$ to encode the message sequence 1101. (10%)

(2). Compute the syndrome for the received word 0111101. (10%)