[Total No. of Questions - 8] **[Total No. of Printed Pages - 4]**
(2125)

15389

M. Tech 1st Semester Examination

Design of Advvance Digital Communication System (NS)

EC-104

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : There are total eight questions. Attempt only five questions out of eight. All questions carry equal marks.

1. (a) Determine the signal space representation of the four signals Sk(t), k=1,2,3,4, shown below, by using a basic functions the orthonormal functions $f_1(t)$ and $f_2(t)$. Plot the signal space diagram and show that this signal set is equivalent to that for a four-phase PSK signal. (10)

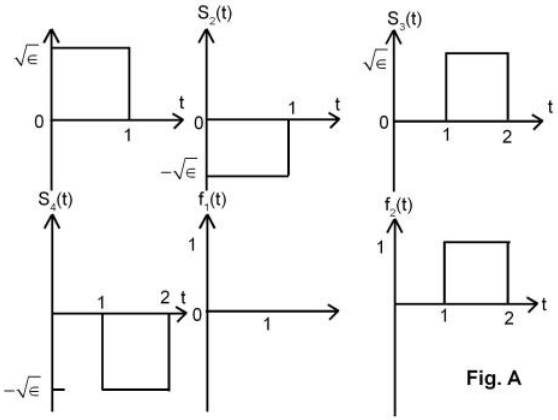


Fig. A

(b) Show that narrowband bandpass signals systems can be presented by equivalent low pass signals & systems. (10)

2. (a) How non-linear modulation methods with memory are different from linear modulation method without memory also.

Show that how CPFSK has continuous phase signal. Find the phase of carrier in any given time interval $nT \leq t \leq (n+1)T$? (10)

(b) Show that spectral characteristic of v(t) can be controlled by design of pulse shape & by design of correlation characteristics of information sequence with the help of power spectra of linearly modulated signal. (10)

3. (a) Derive the probability of error for QAM & also derive the upper bund on symbol error prob for QAM. (10)

(b) The input s(t) to a bandpass filter is

$s(t)=Re[u(t)e^{j2\pi f_c t}]$

where u(t) is a rectangular pulse as shown in Fig. (a)

(a) Determine the outputy$^{(t)}$ of a bandpass filter for all $t \geq 0$ if the impulse response of the filter is

$g^{(t)}=Re[2h(t)e^{j2\pi f_c t}]$

where h(t) is an exponential as shown in Fig. (b)

(b) Sketch the equivalent lowpass output of the filter.

(c) When would you sample the output of the filter if you wished to have the maximum output at the sampling instant? What is the value of the maximum output?

(d) Suppose that in addition to the input signal s(t) there is additive white gaussian noise $n(t)=Re[z(t)e^{j2\pi f_c t}]$. (10)

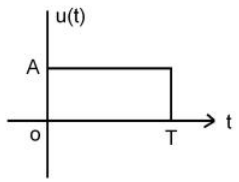


Fig. (a)

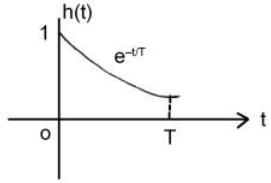


Fig. (b)

4. (a) By deriving equations show that phase error in QAM & M.PSK.

(a) Signals has much more severe effect than in demodulation of PAM signal.

(b) Explain in detail squaring loop [phase recovering technique]. (10)

(b) Explain early gate synchronizer with the help of block diagram. Derive the decision directed phase estimate for linear modulation techniques. (10)

5. (a) Explain DS-SS modulator & demodulator mathematically & draw its block diagrams. Find out expression for processing gain & jamming margin & how performance is dependent on these two factors? (10)

(b) (a) Explain, how tracking is helpful for synchronization in spread-spectrum system.

(b) Consider the DS/BPSK spread-spectrum transmitter of figure 2a. Let $H^{(t)}$ be the sequence 100110001, arriving at a rate of 75 bits/s, where the leftmost bit is the earliest bit. Let $g^{(t)}$ be generated by the shift register of figure 1, with an initial state of 1111 & a clock rate of 225

(i) Sketch the final transmitted sequence $H^{(t)}\, g^{(t)}$.

(ii) What is the bandwidth of the transmitted (spread) signal?

(iii) What is the processing gain?

(iv) Suppose that the estimated delay, $\hat{T}_d$, of figure 2b is too large by one chip time. Sketch the despread chip sequence.

(v) Choose a decision rule for deciding on $H^{(t)}$ & identify the errors. (10)

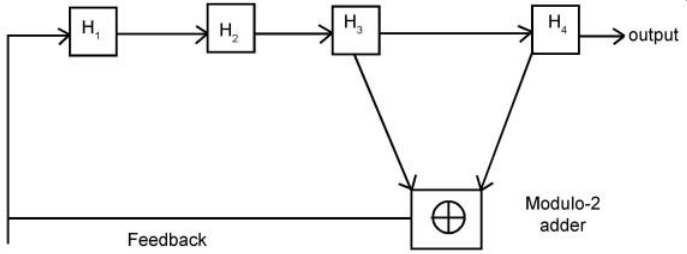


Fig. 1: Linear Feeback shift register example.

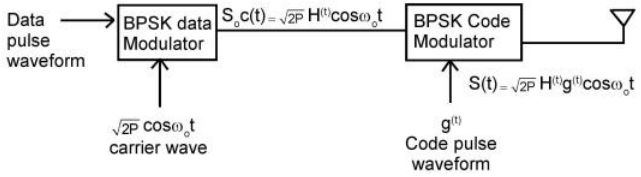
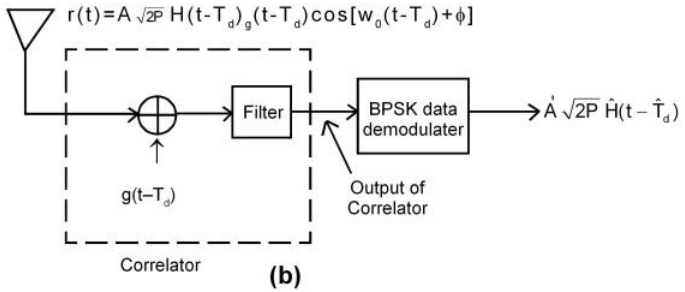


Fig. 2 (a)



(b)

Figure 2: Direct-sequence spread-spectrum system.
(a) BPSK direct sequence tarnsmitter
(b) BPSK direct-sequence receiver.

6. (a) Calculate generalized expression for probability of error when decision threshold is set at optimum value. Find the expression of probability of error when symbols are equally probable. If calculation is done of matched filter output, figure 3 gives pictorial presentation of function erfc(H) and some of its properties. (10)

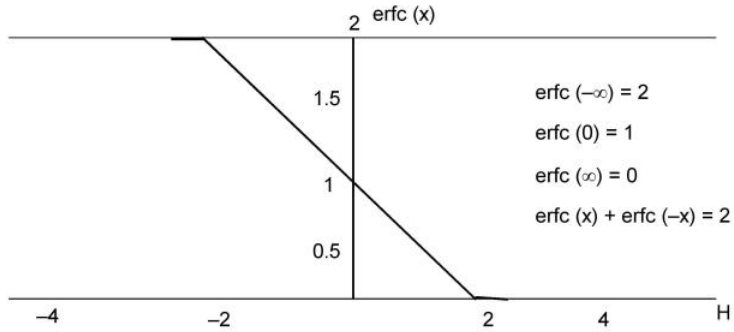


Fig. 3: The plot of erfc(H) us.X.

(b) Derive optimal filter realization using matched filter & also derive probability of error for matched filter. (10)

7. (a) (i) Explain, How data transmission in a multipath environment takes place using (i) single carrier system (ii) multicarrier system.

(ii) In the case of DVB, if N_C=6817, find out the ISI for the maximum delay spread of 0.67μs. The bit rate of the system is 2Mbps. Assume 16QAM modulation mapping. (10)

(b) Draw OFDM Block diagram & explain each block in detail. (10)

8. (a) (i) Describe the transmitted signal for (i) 16 MPSK & (ii) 16 QASK when binary messages to be transmitted are {m(n)}={1,0,1,1,0,1, 0,0,1,1,1,1,0} Consider, digital message input data rate is 10 kbps and average energy per bit is 0.02 unit and carrier frequency = 1MHz.

(ii) If digital message input data rate is 8kbps and average energy per bit is 0.01 unit, find (i) band width required for transmission of the message through BPSK, QPSK, 16MPSK, orthogonal BFSK, MSK and 16MFSK (ii) Put these schemes in order of their susceptibility to noise after calculating minimum separation in signal space. (10)

(b) Explain MSK with the help of waveforms & also describe how the phase continuity is maintained in MSK. (10)