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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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V SEMESTER B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, DECEMBER 2023

COMMUNICATION SYSTEMS [ELE 3151]

REVISED CREDIT SYSTEM

Time: 3 Hours **04 December 2023** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A Justify the use of an equalizer in the PAM demodulation circuit. **3**

1B Design an Armstrong FM transmitter operating at a carrier frequency of 96 MHz and with a permissible frequency deviation of 75 KHz. Draw the block diagram and specify the important parameters at each stage (carrier frequency fc, frequency deviation Δf, modulation index β and modulating signal fm). The following may be assumed to be available. **4**

a) An NBFM generator employing a carrier frequency of 100 KHz and peak frequency deviation of 10 Hz.
b) A variable frequency oscillator (VFO) capable of generating sinusoids with a frequency 10 MHz

1C A sinusoidally modulated standard AM wave with a total power of 5KW has maximum and minimum amplitudes of 10V and 5V respectively. **3**

a) Determine the modulation index.
b) Calculate the efficiency.
c) Determine the amplitude of the carrier which must be added to attain a modulation index of 0.1

2A For a frequency shift keying system, develop a mathematical expression when symbol 1 is received and draw its block diagram. **3**

2B Develop the block diagram of the DPSK transmitter. Sketch the resulting waveform at the transmitter output when the binary sequence applied is 101101. **3**

2C Consider a matched filter with impulse response h(t) = X(T-t). If the signal X(t) shown in Figure 2C is applied to the matched filter: **4**

a) Solve and plot the integrator and dump circuit output as a function of time.
b) Determine the peak value of the matched filter output.

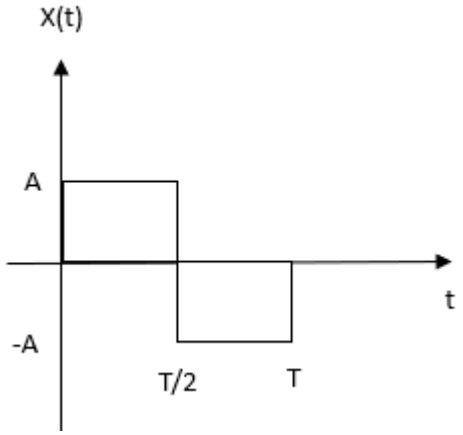

Figure 2C

3A The parity check matrix of a (7,4) linear block code is given by, **2**

$$[H] = \begin{vmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 & 1 \end{vmatrix}$$

Identify the generator matrix and determine the code word for the message 1011

3B A convolutional encoder with rate $r = \frac{1}{2}$ has constraint length K=3 has the generator sequence $g^1(D)$ and $g^2(D)$. They are as follows: **3**

$g^1(D) = (1,0,1)$
$g^2(D) = (0,0,1)$

1. Construct the state diagram for this encoder.
2. Using the state diagram of Part 1, determine the code word corresponding to the message sequence 10110.

Assume the flipflop states.

a	00
b	10
c	01
d	11

3C Perform Viterbi's algorithm to the received sequence 111110 for constraint length K=3, and rate r=1/2 for a convolution encoder whose paths have the generator polynomial coefficients (1,1,1) and (1,0,0). Identify the error location by decoding the received code word. **5**

Assume the flipflop states.

a	00
b	10
c	01
d	11

4A Determine the coded sequence using the generator polynomials $g^{(1)}(D)$ and $g^{(2)}(D)$ for the convolutional encoder with rate r=1/2 and constraint length K=3 for the message 10011. Let $g^{(1)}(D)=1 \oplus_2 D \oplus_2 D^2$ and $g^{(2)}(D)=1 \oplus_2 D^2$ **3**

4B Six independent message signals are sampled, and time multiplexed using PAM. Four of the message signals have a bandwidth of 2.5KHz and the other two have a bandwidth of 5KHz. **3**

a. Compare the transmission bandwidth requirements of Synchronous TDM and Asynchronous TDM

b. Develop the commutator arrangement of Synchronous TDM and Asynchronous TDM

c. Compare the speed of the commutator of Synchronous TDM and Asynchronous TDM

4C For an application, ZigBee standard uses Fast FHSS, with the given specifications. If the input binary sequence transmitted is 1110 and PN sequence generated is 00111001, draw the frequency variation for one complete period of the PN sequence in Fast FHSS. [Let the number of MFSK tones (M) = 4 and length of PN segment per hop (k) = 2, and the carrier is hopped to two different values of PN sequence]. Illustrate the frequency hopping with FHSS transmitter block diagram **4**

5A The data signal applied to a Direct Sequence spread spectrum with coherent BPSK (DS/BPSK) is 0. The system uses a Linear Feedback Shift Register (LFSR) with 4 flip flops and [2,4] as the feedback tap. Consider 0010 as the initial sequence of the LFSR. **4**

a. Construct the LFSR

b. Determine the PN sequence

c. Calculate the processing gain of the system

d. With the help of DS/BPSK transmitter explain and plot DS/ BPSK signal waveform for the given spread spectrum scheme.

5B Assume four stations S1, S2, S3, and S4 are connected to the same channel, and the multiple access technique used is CDMA. The data from S1 is 1, from S2 is 1, from S3 is 0 and from S4 is 0. The code assigned to the first station c1 = [+1 +1 +1 +1], to the second is c2 = [+1 +1 -1 -1], to the third is c3 = [+1 -1 -1 +1], and to the fourth is c4 = [+1 -1 +1 -1]. **3**

a. Determine the data transmitted through the channel.

b. Demonstrate how S1 receives the data, transmitted by S4

5C *a.* For a general symmetric cryptographic system develop the block diagram. Let the symmetric cryptographic system use the Vigenere cipher method encryption algorithm. The key used for the encryption is ***able***. The cipher text received at the destination is **ADNSMQLRYITQ**. Recover the plain text. (Assume the plain and cipher text to be case insensitive.) **3**

Reference:

a	b	c	d	e	f	g	h	i	j	k	l	m
0	1	2	3	4	5	6	7	8	9	10	11	12

n	o	p	q	r	s	t	u	v	w	x	y	z
13	14	15	16	17	18	19	20	21	22	23	24	25