Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2022

COMMUNICATION SYSTEMS [ELE 3151]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 26 NOV 2022** **Max. Marks: 50**

Instructions to Candidates:

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

1A. Two signals $x_1(t)$ and $x_2(t)$ having Fourier transform $X_1(f)$ and $X_2(f)$ shown in figure Q1A, are combined to form $y(t) = x_1(t) + 2x_2(t) \cos 40000\pi t$ which is transmitted over a channel.

a. Draw the spectrum of y(t)
b. Determine the bandwidth of the signal y(t).
c. Design a receiver to recover the signals $x_1(t)$ and $x_2(t)$?

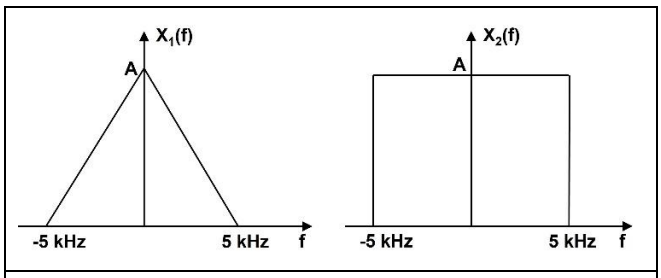

Figure Q1A

(04)

1B. An angle modulated signal is given as $x_c(t) = 10 \cos [\ 10^8 \pi t + 4 \sin (2\pi \times 10^3)t]$. For this signal, determine

a. Modulation index
b. Frequency deviation
c. Spectrum corresponding to a bandwidth of $2(\beta + 1)f_m$ using Bessel function table.

[Note: Refer formula handbook for Bessel function table] ***(03)***

1C. The low pass signal $x(t)$ with a bandwidth of W Hz is sampled with a sampling interval of T_s

$$x_p(t) = \sum_{n=-\infty}^{\infty} x(nT_s)p(t - nT_s)$$

and the signal is reconstructed from the samples, where $p(t)$ is a flat-top pulse of interval $T$with $T < T_s$.

a. Determine the Fourier transform of $x_p(t)$
b. Evaluate the conditions for perfect reconstruction of $x(t)$ from $x_p(t)$
c. Determine the required reconstruction filter. ***(03)***

2A. An analog message signal is limited in its excursions to the range from -10V to +10Volts. If the quantization level is 8 & corresponding codes are located at -8.75V (0), -6.25V (1), -3.75V (2), -1.25V (3), 1.25V (4), 3.75V (5), 6.25V (6), 8.75V (7) then for the sample values 0.3V, 5.2V, -7.6V, -4.8V

a. Determine the PCM encoded words

b. Sketch the electrical representation of PCM codewords using polar NRZ encoding scheme ***(02)***

2B. Consider the signal *s(t)* shown in Figure Q2B.

a) Determine the impulse response of a filter matched to the signal *s(t)* and sketch it as a function of time.

b) Determine the output of the matched filter if s(t) is applied as input, and plot the output as a function of time.

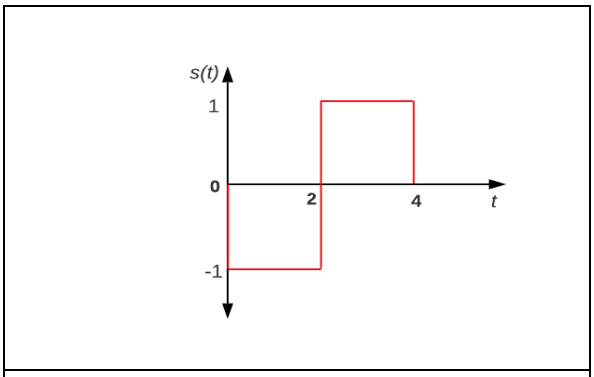

Figure Q2B ***(04)***

2C. For the modulator circuit shown in Figure Q2C the input data rate (R_b) equal to 1Mbps:

a. Determine the bandwidth of the signal $s(t)$ coming out of the linear summer.

b. Determine the signal waveforms $a_1(t)$ and $a_2(t)$for an input bit stream 101100 and plot the waveforms as a function of time. Assume carrier frequency $f_c = R_b$.

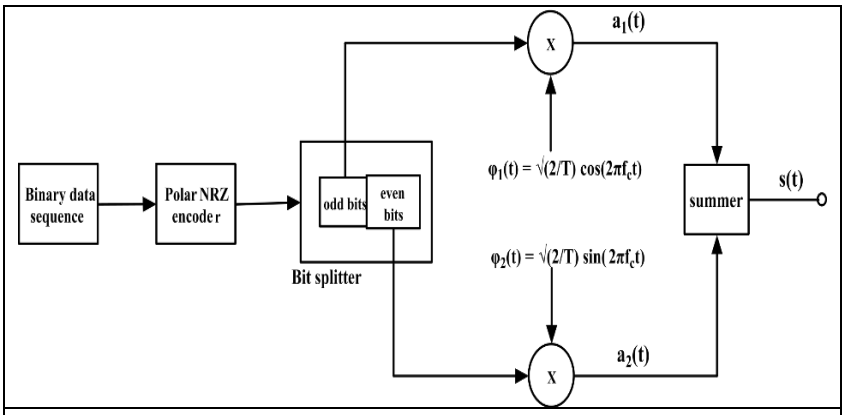

Figure Q2C ***(04)***

3A. For the input (bits) and output shown in fig Q3A determine,

a. The modulation scheme
b. Draw the system level block diagram for the modulator and demodulator circuits.

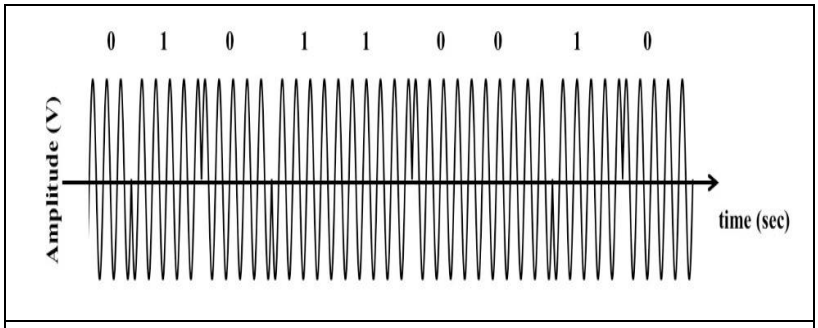

Fig.Q3A

(02)

3B. For the systematic convolutional encoder shown in fig Q3B construct the code tree up to 5 levels and trace the path through the tree that corresponds to the message sequence '**1 0 1 1 1'**.

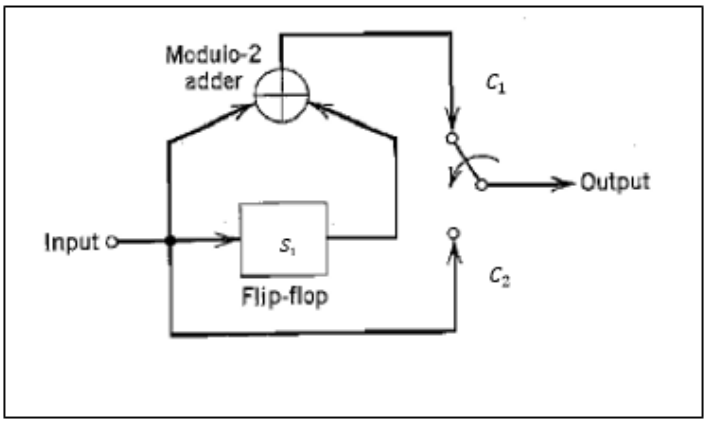

Fig Q3B ***(03)***

3C. Perform Viterbi's algorithm to the received sequence 11101111 for constraint length K=3 and rate r = ½ for a convolution encoder whose paths have the generator polynomial coefficients (1,1,1) and (1,0,1). Identify the error location by decoding the received code word. [Assume the transitions states as: a (00); b(10); c(01); d(11)] ***(05)***

4A. For a (6, 3) linear block code the parity bits are $b_0 = m_0 +_2 m_1$; $b_1 = m_1 +_2 m_2$; $b_2 = m_0 +_2 m_2$.

a. Find the code vector for message sequence [1 1 0]
b. If the received sequence is [1 1 1 0 1 0] then evaluate the syndrome vector. If the received sequence is erroneous then find the location of the error. ***(02)***

4B A direct sequence spread binary phase shift keying system uses three D flip-flops and feedback taps [2, 3].

i. Construct the PN sequence encoder
ii. Determine the PN sequence with initial state 010
iii. Show the waveform of the spreaded code in polar NRZ format for the data bit 1.
iv. If the spreaded sequence is fed to a BPSK modulator draw the transmitted signal. ***(04)***

4C. The table Q4C illustrates the operation of an FHSS system with frequencies f1<f2<f3…..

a. Determine the number of bits per signal element (symbol) used
b. Determine the number of FSK frequencies
c. Determine the length of a PN sequence per hop
d. Determine the total number of possible hop frequencies
e. Determine whether the system is slow or fast FH system
f. sketch the demodulated frequency with time

Table Q4C

Time	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16
Input data	11	01	10	00	00	01	11	01
Frequency	f8	f6	f11	f9	f1	f2	f12	f10
PN sequence	01		10		00		10	

(04)

5A. Assume that Alice sent a cipher text acksenemghtzyatttoni to Bob by using the transposition cipher method for security. The enciphering is performed using two steps. i) rail fencing by depth of 4 and ii) column reading respectively. Column reading is done in the order of key stream: 2 4 1 5 3. Decrypt the plain text send by Alice. Show the steps clearly for rail fencing, and column reading with explanation of transposition cipher method. ***(03)***

5B 10 base band signals each of 500 Hz bandwidth are sampled at the nyquist rate and transmitted by basic TDM system as PAM signals. If the spacing between each pulse is 50 x 10-6s , Determine the width of each pulse ***(03)***

5C. Compare the FDMA, TDMA and CDMA schemes from the mobile/cellular communication point of view ***(04)***