Reg. No.



V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING) MAKEUP EXAMINATIONS, JANUARY 2023

COMMUNICATION SYSTEMS [ELE 3151]

REVISED CREDIT SYSTEM

Time: 3 Hours	Date: 02 JAN 2023	Max. Marks: 50				
Instructions to Candidates:						
Answer ALL the questions						

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- 1A. Two signals, both band limited to 5000 Hz ,are to be transmitted (04) simultaneously over a channel as shown in following figure. The modulated signal at point c is transmitted over a channel.
 - a. Sketch the signal spectra at points **b** and **c**.
 - b. Determine the bandwidth of distortion-free channel.
 - c. Design a receiver to recover the signals m₁(t) and m₂(t) from the modulated signal at point c.



1B. An angle modulated signal has the form

 $s(t) = 100\cos(2\pi \times 10^7 t + 4\sin 2000\pi t)$

- a. Determine the average power
- b. Determine the maximum frequency and phase deviation
- c. Is this an FM or an AM signal? Explain.
- **1C.** Determine the Nyquist rate and Nyquist interval for the following signal **(03)**
 - a. $x(t) = 10 \cos (200\pi t) + 10 \operatorname{sinc}(200t)$
 - b. $x(t) = sinc(200t) sinc^2(1000t)$
- **2A.** A TV signal of bandwidth 4.5 MHz needs to be sampled at a rate 2/9 above **(03)** the Nyquist rate, quantised and binary-coded to obtain a PCM signal
 - a. If the quantisation levels are 1024, determine the number of binary pulses required to encode each sample
 - b. Determine the binary pulse rate (bits per second) of the binary-coded signal.
 - c. Compute the minimum bandwidth required to transmit this PCM signal

(03)

- **2B.** Consider the signal s(t) shown in the below figure.
 - a. Determine and sketch the impulse response matched to the signal
 - b. Determine and sketch the matched filter output as a function of time
 - c. Determine the peak value of the matched filter output



- **2C.** A binary data stream $\{b_k\} = \{010010011\}$ is to be transmitted using DPSK. **(03)** Choosing initial bit $d_{-1} = 1$ and XNOR as the logic network, determine
 - a. The differentially encoded sequence $\{d_k\}$
 - b. Phase of the transmitted signal for every input bit \boldsymbol{b}_k
 - c. Polarity of the integrator output at the end of each bit duration
- **3A.** A digital data stream with each symbol consisting of two bits need to be **(04)** transmitted by employing phase modulation of the carrier.
 - a. Determine the suitable modulation scheme highlighting the governing equation of the modulated signal
 - b. Sketch the signal-space diagram corresponding to the signal points and determine the minimum spacing between the two signal points.
 - c. Sketch the synchronous transmitter and receiver structure for the modulation scheme
- **3B.** Determine the codeword for a message vector [1101] using a (7,4) cyclic (02) encoder. Assume the generator polynomial $g(x) = 1 + X + X^3$
- **3C.** The trellis diagram of a convolutional encoder with code rate equal to ½ is as **(04)** shown below (branch with bold line corresponds to a 0 input and the branch with dashed line corresponds to a 1 input). Perform the Viterbi algorithm to decode the sequence (1110101100).



- 4A. For a convolutional encoder with code rate = ½ and impulse responses as (1 (04) 0 1) and (1 1 1)
 - a. Sketch the convolutional encoder
 - b. Determine the state transition table
 - c. Sketch the trellis diagram up to level 4

- **4B.** A direct sequence spread binary phase shift keying system uses three D flip- **(03)** flops and feedback taps [1, 3].
 - a. Construct the PN sequence encoder
 - b. Determine the PN sequence with initial state 110
 - c. Show the waveform of the spreaded code in polar NRZ format for the data bit 0.
- **4C.** The table below illustrates the operation of an FHSS system with frequencies (03) 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

Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PN	00	11	01	10	00	10	00	11	10	00	10	11	11	01	00	10
Sequence																
Input data	0	1	1	1	0	0	1	1	1	1	0	1	1	0	0	0
Frequency	f2	f14	f8	f12	f1	f9	f4	f16	f12	f4	f10	f14	f15	f7	f1	f5

- 5A. Assume that John sent a cipher text TTNAAPTMTSUOAODWCOIXKNLYPETZ 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: 4 3 1 2 5 6.7. Decrypt the plain text sent by John. Show the steps clearly for rail fencing, and column reading with explanation of transposition cipher method.
- **5B** A TDM link has 20 signal channels, and each channel is sampled at 8 kHz.
 603 Each sample is represented by 7 bits and contains an additional bit for synchronisation. Determine the total bit rate for the TDM link.
- **5C.** Explain the functions of the OSI model's Data Link and Network layers with **(04)** neat diagram.