

## Part-I (2 Marks questions)

### Unit-I: Elements of Digital Communication Systems

S. No	Question	Blooms Taxonomy	Program Outcome
1	Explain the simplified Block diagram of an Electronic communication system with the help of diagram.	Understand	1
2	List two examples each for analog and digital signals (in mathematical form).	Remember	2
3	Explain Shannon & Hartley's Law.	Evaluate	4
4	Construct the equation for Shannon limit on Information capacity.	Create	3
5	Explain about trade-off between bandwidth and SNR in a communication signal.	Evaluate	6
6	Define bandwidth.	Remember	5
7	Define Nyquist Sampling theorem.	Remember	8
8	Construct the mathematical expression for Minimum sampling rate (fs).	Create	2
9	Examine Aliasing Effect (or) Fold-over distortion? How it can be removed.	Analyze	1
10	List the advantages of digital communication systems	Analyze	2

### UNIT-I Pulse Code Modulation

S. No	Question	Blooms Taxonomy	Program Outcome
1	Summarize differential encoding signaling? Explain with an example.	Understand	1
2	Define quantization in PCM.	Remember	2
3	Explain a simple model of nonuniform quantizer.	Understand	4
4	Define the term quantization noise.	Remember	3
5	Compare the features of PCM and DPCM.	Analyze	6
6	List the advantage gained by the use of robust quantization.	Remember	5
7	Define an output signal-to-quantization ratio.	Remember	8

8	Mention two major sources of noise which influence the performance of a PCM system.	Knowledge	2
9	Discuss the advantages of DM over PCM.	Create	1
10	Construct the block diagram of pulse code modulation.	Apply	2
11	Define quantization noise power	Remember	1
12	Discuss about uniform quantization?	Create	2
13	Discuss about Quantization?	Create	4
14	Compare uniform and non-uniform quantization	Analyze	3

### Unit-II Digital Modulation Techniques

S. No	Question	Blooms Taxonomy	Program Outcome
1	Construct the ASK and FSK waveforms for 011011.	Apply	2
2	Sketch the block diagram of ASK generation.	Remember	1
3	Examine how does pulse shaping reduce inter symbol interference?	Analyze	2
4	Show the space representation of BPSK and QPSK	Remember	1
5	Explain the Bandwidth, power and energy calculations for PSK signal.	Evaluate	2
6	Explain why PSK is always preferable over ASK in coherent detection?	Evaluate	4
7	Distinguish between Coherent and Non coherent detection?	Analyze	3
8	Explain Phase shift keying with relevant equations and waveforms.	Understand	2
9	Estimate the band width required for frequency shift keying and draw its spectrum.	Create	1
10	Explain non coherent detection of Amplitude shift keying.	Understand	2
11	Construct the constellation diagram for Quadrature phase shift keying.	Apply	1
12	Explain coherent detection of frequency shift keying .what should be the relationship between bit rate and frequency shift for a better performance?	Evaluate	2
13	Construct the FSK waveforms for a given input data "1101".	Apply	4
14	Define the probability of error.	Remember	3

### Unit-III Base Band Transmission and Optimal Reception of Digital Signal

S. No	Question	Blooms Taxonomy	Program Outcome
1	What is a matched filter?	Remember	1

2	List two applications for eye pattern.	Analyze	2
3	What are eye pattern?	Remember	4
4	Discuss the performance of data transmission system using eye pattern technique?	Create	3
5	Discuss the need of optimum transmitting and receiving filter in baseband data transmission.	Create	6
6	What is the value of maximum signal to noise ratio of the matched filter? When it becomes maximum?	Remember	5
7	Construct the block diagram of Base band System.	Create	8
8	Examine Crosstalk.	Analyze	2
9	Explain Optimum Receiver.	Understand	1
10	Explain Signal Space Representation.	Understand	2
11	What does the width of the eye define?	Remember	1
12	Make use of the eye pattern and how the sensitivity on the system can be determined?	Apply	2

### Unit-III Information Theory

S. No	Question	Blooms Taxonomy	Program Outcome
1	What is meant by distortion less transmission?	Remember	4
2	Discuss entropy and give the expression for it.	Creating	3
3	Explain the channel capacity theorem.	Understand	6
5	Let X represents the outcome of a single roll of a fair die. What is the entropy of X?	Remember	5
6	What is transition probability and when it does it will occur?	Remember	8
7	Explain the two properties of Mutual information.	Understand	2
8	State the properties of Entropy	Creating	1
9	What is discrete memory less channel and give the channel matrix expression	Understand	2
10	What is channel coding theorem and how it is different from source coding theorem?	Understand	1
11	What is entropy? Show that the entropy is maximum when all the symbols are equi probable. Assume $M=2$ .	Understand	2
12	Define information. Show that information contained by a symbol is inversely proportional to the probability of that symbol.	Create	4

### Unit-IV Linear Block Codes & Cyclic Codes

S. No	Question	Blooms Taxonomy	Program Outcome
1	What is linear code?	Remember	4
2	Discuss code rate?	Create	3
3	Define code efficiency.	Remember	6

4	Explain hamming distance?	Understand	5
5	What is meant by systematic & non-systematic code?	Remember	8
6	Explain how syndrome is calculated in Hamming codes and cyclic codes?	Evaluate	2
7	What are the conditions to satisfy the hamming code?	Remember	4
8	Define code word & block length.	Remember	3
9	What are the advantages of cyclic codes?	Remember	6
10	What is linear code?	Remember	5

### Unit-IV Convolutional Codes

S. No	Question	Blooms Taxonomy	Program Outcome
1	What is constraint length of convolution code.	Understand	5
2	List advantages of convolutional codes	Understand	8
3	Discuss the difference between convolutional code and block code.	Create	2
4	Construct the graphical representations of convolutional codes.	Create	4
5	Construct the encoding diagram for (3, 2, 1) convolutional encoder.	Apply	3
6	What is sequential decoding?	Understand	6
7	Explain about the Convolutional interleaving.	Evaluate	5
8	Compare coded and uncoded transmission techniques with respect to Probability of error.	Evaluate	5
9	What is the code length of a convolution code?	Understand	8
10	Examine the time-domain approach in convolution code.	Analyze	2
11	What is the importance of code tree?	Understand	4
12	Define the term trellis in convolution code.	Remember	3
13	Explain Viterbi algorithm.	Create	6
14	Discuss maximum-likelihood decoding rule for the binary symmetric channel.	Create	5

### Unit-V Spread Spectrum Modulation

S. No	Question	Blooms Taxonomy	Program Outcome
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1	Define spread spectrum communication	Remember	4
2	Explains pseudo noise sequence?	Understand	3
3	Discuss direct sequence spread spectrum modulation	Create	6
4	What is frequency hop spread spectrum modulation?	Remember	5
5	What is processing gain?	Understand	8
6	State four applications of spread spectrum.	Create	2
7	When is the PN sequence called as maximal length sequence?	Analyze	1
8	What is meant by processing gain of DS spread spectrum system?	Understand	2
9	Discuss the applications of spread spectrum modulation?	Create	1
10	Define frequency hopping.	Understand	2
11	What are the Advantages of DS-SS systems?	Remember	4
12	What are the Disadvantages of DS-SS systems?	Remember	4
13	List the Advantages of FH-SS System	Analyze	3
14	List the Disadvantages of FH-SS System	Analyze	4

### Part-II (10 Marks questions)

#### Unit-I: Elements of Digital Communication Systems

S. No	Question	Blooms Taxonomy	Program Outcome
1	Explain the different types of Sampling.	Understand	5
2	Distinguish between natural sampling and flat top sampling with neat schematics, listing out their merits and demerits.	Analyze	8
3	Explain the principle of working a sample and hold circuit. List out its applications with neat diagrams.	Evaluate	2
4	Define the sampling theorem as applicable to voice signals on telephone lines.	Remember	4
5	Discuss the advantages and disadvantages of digital communication system.	Create	3
6	Discuss and prove sampling theorem in time domain.	Create	6
7	Define natural sampling? Explain it with sketches.	Remember	5
8	Discuss the Hartley-Shannon law.	Create	5
9	Explain the Model of Digital Communication Systems with neat diagrams.	Understand	8
10	Explain Bandwidth-S/N Tradeoff	Understand	2

#### UNIT-I Pulse Code Modulation

S. No	Question	Blooms Taxonomy	Program Outcome
1	Illustrate the working of DPCM transmitter and receiver with the help of diagram.	Understand	5
2	Enumerate the quantization error in delta modulation.	Application	8
3	List the comparison between PCM and DM systems.	Remember	2
4	Elaborate how to avoid slope overload distortion in DM.	Create	4
5	Illustrate the working of Adaptive DPCM with the help of diagram.	Understand	3
6	Illustrate the working of Adaptive DM with the help of diagram.	Understand	6
7	Explain the Companding.	Evaluate	5
8	Explain a) Channel Noise b) Quantization noise in DM and derive expression for them?	Evaluate	5
9	Explain the need for non-uniform quantization in digital communications.	Comprehension	8
10	Explain the Block diagram of DPCM system.	Understand	2
11	Discuss quantization error? How does it depend upon the step size? Suggest some methods to overcome the difficulties encountered depending on the modulating Amplitude swing?	Create	4

## Unit-II Digital Modulation Techniques

S. No	Question	Blooms Taxonomy	Program Outcome
1	Explain in detail about i. i)FSK ii. ii)PSK with waveforms and equations	Understand	5
2	Determine probability of error for a) ASK and b) PSK systems.	Create	8
3	a) Explain the demodulation of FSK using coherent detection. b) Draw the block diagram of QPSK receiver.	Create	2
4	Explain the generation of PSK signals.	Understand	4
5	a) Discuss QPSK signaling. b) Derive the bit error probability due to PSK receiver.	Create	3
6	Solve that the maximum output signal to noise ratio of a matched filter is $(SNR) = 2E/N_0$	Create	6
7	Explain Differential phase shift keying modulation with neat block diagram. Draw the wave forms.	Create	5
8	Show that the probability of error for phase shift keying is $P_e = Q(\sqrt{2S_{av} T_b / N_0})$ and the threshold level is zero.	Remember	5

9	The bit stream 11011100101 is to be transmitted using DPSK. Determine the encoded sequence and the transmitted phase sequence.	Evaluate	8
10	Explain the working of DPSK modulator and demodulator.		a

### Unit-III Base Band Transmission and Optimal Reception of Digital Signal

S. No	Question	Blooms Taxonomy	Program Outcome
1	Explain Pulse Shaping for Optimum Transmission.	Understand	5
2	Explain A Baseband Signal Receiver.	Understand	8
3	Explain Optimum Receiver	Evaluate	2
4	Explain Optimal of Coherent Reception	Evaluate	4
5	Explain Signal Space Representation	Evaluate	3
6	With Neat diagram, explain Eye Diagrams	Understand	6
7	Explain Cross Talk	Understand	5
8	Why equalization is necessary in Baseband transmission? Give the block diagram of adaptive filter and explain about each element.	Remember	5
9	Explain the base band transmission of M-ary data with suitable diagrams.	Understand	8
10	What is matched filter? Derive the expression for its output SNR.	Remember	2
11	a) What is an inter symbol interference in baseband binary PAM system? Explain. b) Give the basic components of a filter in baseband data transmission and explain.	Remember	4

### Unit-III Information Theory

S. No	Question	Blooms Taxonomy	Program Outcome
1	Show that the entropy for a discrete source is a maximum when the output symbols are equally probable.	Understand	5
2	Show that the mutual information of a channel is related to the joint entropy of the channel input and channel output.	Understand	8
3	Explain Shannon-fano coding algorithm using an example.	Creating	2
5	Explain the Huffman coding algorithm using an example.	Analyse	4
6	Explain the Conditional Entropy.	Apply	3
7	Explain the Redundancy.	Evaluate	6
8	Explain the Mutual Information	Creating	5

9	Explain the Variable length Coding with an example	Analyse	5
10	Explain the Lossy Source Coding	Creating & Analyse	8

### Unit-IV Linear Block Codes & Cyclic Codes

S. No	Question	Blooms Taxonomy	Program Outcome
1	Explain syndrome decoding for cyclic code expression.	Creating & analyze	5
2	What is parity check matrix and how it is used?	Remember	8
3	Explain systematic cyclic code generation formula	Creating & analyze	2
4	What are minimum distance considerations?	Remember	4
5	Show that the syndrome depends only on the error pattern, and not on the transmitted code word.	Remember	3
6	Show that the minimum distance of a linear block code is equal to the minimum number of rows of HT that sum to zero.	Remember	6
7	Analyze and prove the fundamental properties of cyclic code.	Analyze	5
8	Show that if $c_i$ and $c_j$ are two code vectors in an $(n,k)$ linear block code, then their sum is also a code vector.	Remember	5
9	The generator polynomial of $(15,11)$ cyclic code is $g(x) = 1+x+x^4$ . Determine the parity polynomial $h(x)$ of this code.	Evaluate	8

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### Unit-IV Convolutional Codes

S. No	Question	Blooms Taxonomy	Program Outcome
1	Compare the linear block codes, cyclic codes and the convolutional codes?	Evaluate	5
2	Draw an $(n-k)$ syndrome calculation circuit for an $(n, k)$ cyclic code?	Understand	8
3	What is meant by random errors and burst errors? Explain about a coding technique which can be used to correct both the burst and random errors simultaneously.	Remember	2
4	Discuss about the various decoders for convolutional codes.	Create	4
5	Explain how the channel coding reduces the probability of error.	Evaluate	3
6	Explain the systematic code form for the binary cyclic codes?	Evaluate	6
7	Explain about block codes in which each block of $k$ message bits encoded into block of $n > k$ bits with an example.	Evaluate	5
8	Demonstrate the Viterbi algorithm for maximum-likelihood decoding of convolutional codes.	Create	5

9	What is a convolutional code? How is it different from a block code?	Remember	8
10	Compare the Error Rates in Coded and Uncoded Transmission	Understand	7

### Unit-V Spread Spectrum Modulation

S. No	Question	Blooms Taxonomy	Program Outcome
1	Explain the spread spectrum modulation and demodulation.	Create	5
2	Explain the frequency hopping spread spectrum modulation.	Evaluate	8
3	Examine spread spectrum modulation using DSSS.	Analyze	2
4	Explain the spread spectrum modulation.	Understand	4
5	Explain the frequency hopping spread spectrum modulation.	Evaluate	3
6	a) Explain how PN sequences are generated. What are maximal-length sequences? What are their properties and why are they preferred? b) With the help of a neat block diagram, explain the working of a DS spread spectrum based CDMA system.	Understand	6
7	a) What are the advantages of spread spectrum technique.	Remember	5
8	b) Compare direct sequence spread spectrum and frequency hopped spread spectrum techniques and draw the important	Analyze	5
9	a) What are the PN sequences? Discuss the characteristics. b) What are the two basic types of spread-spectrum systems? Explain the basic principle of each of them.	Remember	8
10	Explain the spread spectrum modulation.	Understand	2
11	Explain the frequency hopping spread spectrum modulation.	Understand	4

### Part-III (Problems and Analytical Thinking)

#### Unit-I Elements of Digital Communication Systems

S. No	Question	Blooms Taxonomy	Program Outcome
1	Estimate Nyquist rate and Nyquist interval for the signal $10 \cos(2000\pi t) \cos(4000\pi t)$ based on Low pass sampling theory	Evaluate	8
2	A signal $m(t) = 4 \cos(60\pi t) + 2 \cos(160\pi t) + \cos(280\pi t)$ is sampled at i. 150 Hz, ii. 75 Hz, iii. 300 Hz. Estimate the frequency components of the signal that appear at	Evaluate	7

	the output of an ideal LPF with cutoff at 290 Hz. in each case. What is the Nyquist rate of sampling and Nyquist interval for $m(t)$ ?		
3	Solve the Nyquist rate and Nyquist intervals for each of the following signals i) $x(t) = \text{Sinc}200t$ ii) $x(t) = \text{Sinc}200t$ iii) $x(t) = \text{Sinc}200t + \text{Sinc}200t$ .	Create	5
4	The terminal of a computer used to enter alphanumeric data is connected to the computer through a voice grade telephone line having a usable bandwidth of 3KHz and a output SNR of 10 dB. Determine the capacity of the channel.	Evaluate	8
5	A signal $m(t) = 4 \cos(60\pi t) + 2 \cos(160\pi t) + \cos(280\pi t)$ is sampled at a) 150 Hz, b) 75 Hz, c) 300 Hz. Determine the frequency components of the signal that appear at the output of an ideal LPF with cut off at 290 Hz. in each case. What is the Nyquist rate of sampling and Nyquist interval for $m(t)$ ?	Evaluate	2

### UNIT-I Pulse Code Modulation

S. No	Question	Blooms Taxonomy	Program Outcome
1	A TV signal with a bandwidth of 4.2MHz is transmitted using PCM with 512 quantization levels. Solve binary word code length and transmitted bit rate.	Apply	5
2	The input to the delta modulator is $m(t) = 5t$ and sampling rate is 5000 samples/sec. Determine the step size.	Evaluate	8
3	An analog signal is sampled at the Nyquist rate of 20KHz and quantized into $L=1024$ levels. Solve the bit rate and the time-duration of one bit of the binary encoded signal.	Create	2
4	A six bit single channel PCM system gives an output of 60 kilobits per second. Determine the highest possible modulating frequency for the system.	Evaluate	4
5	The input to the delta modulator is $5\cos 2\pi 1000t$ . The pulse rate is 56,000 pulses/sec. Determine the step size	Evaluate	3
6	A signal $m(t)$ Band limited to 4 kHz is sampled at twice the Nyquist rate & its samples transmitting by PCM. An output SNR of 47 dB is required: (a) Solve $N$ and minimum value of $S_i/N_i$ of operation is to be above threshold (b) Solve minimum system Band width required and find signaling rate needed to achieve the given output SNR.	Apply	6
7	A voice frequency signal band limited to 3 KHz is transmitted with the use of the DM system. The prf is 30,000 pulses/second and step size is 40 mV. Determine the maximum permissible speech signal amplitude to avoid error.	Evaluate	5
8	For a DM system, signal sampled at 76 KHz and $A_{max} = 4$ (a) Assuming that the signal is sinusoidal determine output	Evaluate	5

	signal power & SNR. (b) Determine the minimum transmission Band width? Derive the relations.		
9	The input to the PCM system is $m(t)=10\cos 2\pi \times 104t$ , the signal is sampled at nyquist rate, each sample is encoded in to 4-bits. Determine i) Bit rate ii) Bandwidth, iii) Signal to Noise ratio	Evaluate	8
10	The input to the DM is $m(t)=8\sin 2\pi \times 104t$ . The step size $\delta=0.314$ volts. Determine the bit rate.	Evaluate	2

### Unit-II Digital Modulation Techniques

S. No	Question	Blooms Taxonomy	Program Outcome
1	For the signals, the given bit rate is 10Kbps. Estimate the bandwidth for ASK and FSK signals.	Evaluate	5
2	Assume that 3600 bits/sec data is sent over a pass band channel by FSK signaling scheme. Estimate the transmission bandwidth.	Create	8
3	A voice signal is sampled at the rate of 5000samples/sec and each sample is encoded into 5-bits using PCM system. The binary data is transmitted into free space after modulation. Determine the bandwidth of the modulated signal, if the modulation used is a) ASK b) PSK c) FSK where $f_1=8\text{MHz}$ and $f_2=6\text{MHz}$ .	Evaluate	2
4	Binary data is transmitted over an RF band pass channel with a usable bandwidth of 10MHz at a rate of $4.8 \times 10^6$ bits/sec using an ASK signaling method. The carrier amplitude at the receiver antenna is 1mV and noise power spectral density at the receiver input is 10-15Watt/Hz. Determine the error probability of a coherent receiver.	Evaluate	4
5	Assume that 4800 bits/sec random data are sent over band pass channel by using the following schemes: A) BPSK b) FSK Determine the Transmission bandwidth.	Evaluate	3

### Unit-III Base Band Transmission and Optimal Reception of Digital Signal

S. No	Question	Blooms Taxonomy	Program Outcome
1	A certain telephone line bandwidth is 4 KHz. Calculate the data rate in bps that can be transmitted if we use binary signaling with raised cosine pulses and a roll off factor $\alpha=0.25$ .	Apply	5

2	In a certain telemetry system, eight message signals having 2 kHz bandwidth each are time division multiplexed using a binary PCM Technique .the error in sampling amplitude cannot be greater than 1% of the peak amplitude. Determine the minimum transmission bandwidth required if raised cosine pulses with roll off factor $\alpha=0.2$ are used the sampling rate must be at least 25% above the Nyquist rate.	Evaluate	8
3	A telephone line of bandwidth 4Khz required to transmit data at 6kbps using raised cosine pulses. Determine the roll of factor $\alpha$	Evaluate	2
4	The unequalized pulse in a PAM system has the following values at sampling times: $pr(kT_b) = pr(k) = \begin{cases} 0.8 & k=0 \\ 0.2 & k = -1 \end{cases}$ $pr(k) = 0 \text{ for }  k  > 1$ Design a three-tap zero forcing equalizer so that the equalizer output is 1 at $k = 0$ and 0 at $k = \pm 1$	Create	4

### Unit-III Information Theory

S. No	Question	Blooms Taxonomy	Program Outcome
1	Consider a discrete memory less source with source alphabet $S = \{s_0, s_1, s_2\}$ and source statistics $\{0.7, 0.15, 0.15\}$ . Calculate the entropy of source.	Understand	5
2	An event has six possible outcomes with the probabilities $P_1 = 1/2, P_2 = 1/4, P_3 = 1/8, P_4 = 1/16, P_5 = 1/32, P_6 = 1/32$ . What is the entropy of the system?	Remember	8
3	A DMS X has 4 symbols $x_1, x_2, x_3, x_4$ with $p(x_1) = 1/2, p(x_2) = 1/4, p(x_3) = 1/8 = p(x_4)$ . Construct Shannon-fano code. Repeat for the Huffman code and compare the results.	Create	2
4	Consider the binary symmetric channel. Let $P_0$ denote the probability of choosing binary symbol $X_0=0$ and let $P_1 = 1 - P_0$ denote the probability of choosing binary symbol $X_1=1$ . Let $p$ denote the transition probability of the channel. Calculate the average mutual information between the channel input and channel	Apply	4
5	A source emits one of four possible symbols during each signaling interval. The symbols occur with the probabilities. $p_1=0.4, p_2=0.3, p_3=0.2, p_4=0.1$ . Estimate the information gained by observing the source emitting each of these symbols.	Evaluate	3

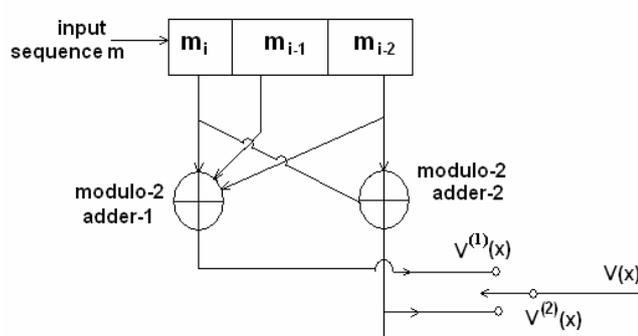
6	<p>a) A source emits one of 4 symbols <math>s_0, s_1, s_2, s_3</math> with probabilities <math>1/3, 1/6, 1/4, 1/4</math> respectively. The successive symbols emitted by the source are statistically independent. Calculate the entropy of the source.</p> <p>b) Derive the channel capacity theorem for discrete channels.</p>	Evaluate	6
7	A source emits one of the four possible messages $m_1, m_2, m_3, m_4$ with the probabilities $1/2, 1/4, 1/8, 1/8$ respectively. Calculate the information content of each message and average information per message.	Evaluate	5
8	A source emits an independent sequence of symbols from an alphabet consisting of five symbols A, B, C, D and E with symbol probabilities $1/4, 1/8, 1/8, 3/16, 5/16$ respectively. What is the entropy of the source?	Remember	5
9	A discrete source emits one of five symbols once every millisecond. The symbol probabilities are $1/2, 1/4, 1/8, 1/16, 1/16$ respectively. What is the source entropy and information rate?	Remember	8
10	Estimate the entropy of a source that emits one of three symbols A,B, C in a statically independent sequence with probabilities $1/2, 1/4, \text{ and } 1/4$ respectively.	Create	2

### Unit-IV Linear Block Codes & Cyclic Codes

S. No	Question	Blooms Taxonomy	Program Outcome
1	<p>For a (6, 3) systematic linear block code, the three parity check bits <math>c_4, c_5, c_6</math> are formed from the following equations.</p> $C_4 = d_1 + d_3$ $C_5 = d_1 + d_2 + d_3$ $C_6 = d_1 + d_2$ <p>a) Construct the generator matrix G. b) Construct all possible code words.</p>	Create	5
2	<p>Consider the (8,4) linear block code with <math>G =</math></p> $\begin{matrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 \end{matrix}$ <p>(a) Construct all the possible code words (b) Construct all the single error patterns.</p>	Create	8
3	<p>For a cyclic code the generator polynomial <math>g(x) = (x^3 + x^2 + 1)</math>.</p> <p>a) If the received code is 1000110, determine the transmitted data. b) If the received code is 1101101, determine the transmitted data.</p>	Evaluate	2
4	Consider a (7,4) cyclic code with generator polynomial $g(x) = (x^3 + x^2 + 1)$ . Determine the code for data bits 1010, 1111, and 0001	Evaluate	4
5	Show that the syndrome S is the sum of those rows of matrix HT corresponding to the error locations in the error pattern.	Understand	3

6	Consider the (8,4) linear block code with G= a) Construct all the possible code words b) Construct all the single error patterns.	Create	6
7	The polynomial $x^{15}+1$ when factored gives $x^{15}+1=(x^4+x^3+1)(x^4+x^3+x^2+x+1)(x^4+x+1)(x^2+x+1)(x+1)$ a) Construct a systematic (15,5)code using the generator polynomial $g(x)=(x^4+x^3+x^2+x+1)(x^4+x+1)(x^4+x^3+1)(x+1)$ . b) What is the minimum distance of the code? c) How many random errors per code word can be corrected?	Understand	5
8	The generator polynomial of a (7, 4) cyclic code is $g(x) = 1+x+x^3$ . Find the 16 code words of this code: a) By forming the code polynomials using $v(x) = D(x)g(x)$ , where $D(x)$ is the message polynomial. b) Draw the encoder block diagram?	Understand	5
9	For a (6,3) systematic linear block code the three parity check bits $c_4, c_5, c_6$ are formed from the following equations: $c_4=d_1$ (xor) $d_3$ ; $c_5= d_1$ (xor) $d_2$ (xor) $d_3$ ; $c_6= d_1$ (xor) $d_2$ . a) Write down the generator matrix G b) Suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bit	Understand	8
10	Construct all the possible systematic code words for (15,5) cyclic code with the following generator polynomial $g(x)=x^{10}+x^8+x^5+x^4+x^2+x+1$ . Construct the encoder circuit for this.	Create	2

### Unit-IV Convolutional Codes

S. No	Question	Blooms Taxonomy	Program Outcome
1	Find the code word for data word 1110 in a (7,4) cyclic code using the generator polynomial $g(x)=1+x^2+x^3$ using encoder.	Remember	5
2	The generator matrix for (7,4) block code is given below	Understand	8
3	Find the generator matrix G(D) for the (2, 1, 2) convolutional encoder of figure shown  	Remember	2

4	Consider the (3,1,2) nonsystematic convolution encoder with $g^{(0)} = (1, 1, 0)$ , $g^{(1)} = (1, 0, 1)$ , $g^{(2)} = (1, 1, 1)$ . Draw the encoder block diagram.	Apply	4
5	A convolution encoder has 3 shift registers with two stages, two modulo-2 adders and an output multiplexer. The generator sequences of the encoder are as follows. $g^{(1)} = (1, 1, 1, 1)$ ; $g^{(2)} = (1, 1, 0, 1)$ . Draw the block diagram of the encoder.	Apply	3
6	Consider the (3,1,2) nonsystematic convolution encoder with $g^{(0)} = (1, 1, 0)$ , $g^{(1)} = (1, 0, 1)$ , $g^{(2)} = (1, 1, 1)$ . What the generator matrix for this code.	Remember	6
7	Consider the (3,1,2) nonsystematic convolution encoder with $g^{(0)} = (1, 1, 0)$ , $g^{(1)} = (1, 0, 1)$ , $g^{(2)} = (0, 1, 1)$ . Find the constraint length and the rate efficiency of the code.	Remember	5
8	A convolution encoder has 3 shift registers with two stages, two modulo-2 adders and an output multiplexer. The generator sequences of the encoder are as follows. $g^{(1)} = (1, 1, 1, 1)$ ; $g^{(2)} = (1, 1, 0, 1)$ . Find the constraint length and the rate efficiency of the code.	Remember	5
9	Define constraint length and rate efficiency of convolution code.	Remember	8
10	Examine the differences between linear block codes and convolution codes.	Understand	2
11	Define metric and survivors in Viterbi algorithm with one example.	Remember	4