SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

V SEMESTER

EC3561 – DIGITAL COMMUNICATION

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EC3561 – DIGITAL COMMUNICATION

UNIT I - INFORMATION THEORY

Discrete Memoryless source, Information, Entropy, Mutual Information – Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity – Hartley – Shannon law – Source coding theorem – Shannon – Fano & Huffman codes.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Draw the basic block diagram of digital communication system.	CO1	BTL 1	Remembering
2.	What are the merits of digital communication?	CO1	BTL 1	Remembering
3.	State the concept of discrete memory less source.	CO1	BTL 1	Remembering
4.	Write the two properties of information.	CO1	BTL 2	Understanding
5.	Define information rate.	CO1	BTL 2	Understanding
6.	Identify the amount of information if $p_k = 1/4$.	CO1	BTL 2	Understanding
7.	State the principle that explains why the amount of information is zero if the receiver knows the message being transmitted.	CO1	BTL 1	Remembering
8.	Find the total amount of information, when a source emits 2 symbols whose probabilities are 0.2 and 0.1.	CO1	BTL 1	Remembering
9.	Write the formulae to find the code length and code efficiency.	CO1	BTL 2	Understanding
10.	State entropy.	CO1	BTL 1	Remembering
11.	Write the two properties of entropy.	CO1	BTL 2	Understanding
12.	Identify the entropy of the system for an event that has six possible outcomes with probabilities 1/2,1/4,1/8,1/16,1/32,1/32?	CO1	BTL 2	Understanding
13.	What is mutual information?	CO1	BTL 1	Remembering
14.	List out the properties of mutual information.	CO1	BTL 1	Remembering
15.	Outline the concept of discrete memory less channel.	CO1	BTL 2	Understanding
16.	Write down the expression for Kraft-McMillan inequality.	CO1	BTL 2	Understanding

17.	List out the special type of channels apart from the continuous and discrete channels.		CO1	BTL 2	Understanding
18.	State the concept of BSC.		CO1	BTL 1	Remembering
19.	Define channel capacity.		CO1	BTL 1	Remembering
20.	Write down the formulae of Hartley law.		CO1	BTL 2	Understanding
21.	Point out Shannon law.		CO1	BTL 1	Remembering
22.	Name the source coding techniques.		CO1	BTL 1	Remembering
23.	List the steps for Huffman coding algorithm.		CO1	BTL 1	Remembering
24.	Why is Huffman code called as minimum redundancy code?		CO1	BTL 2	Understanding
	PART B				
1.	Sketch the block diagram of digital communication system and elaborate it.	(16)	CO1	BTL 4	Analyzing
2.	(i) Explain about the information source, amount of information (ii) Find the total amount of information, when a source emits 03 symbols whose probabilities are 0.2, 0.3 and 0.5.	(8) (8)	CO1	BTL 3	Applying
3.	(i) Illustrate the properties of discrete memoryless source. (ii) Interpret the structure of Channel matrix and explain its components.	(8) (8)	CO1	BTL 3	Applying
4.	Discuss the significance of entropy in the communication and evaluate its Entropy properties.	(16)	CO1	BTL 4	Analyzing
5.	(i) Examine the concept of extension of a discrete memory less source. (ii) Analyze the entropy of a source which emits 2 symbols which are equally likely. S_1 and $S_2 = \frac{1}{2}$.	(8) (8)	CO1	BTL 4	Analyzing
6.	Explain the types of channels in detail.	(16)	CO1	BTL 3	Applying
7.	(i) Elaborate the conditional and joint entropies. (ii) Determine the mutual information properties with proof.	(8) (8)	CO1	BTL 4	Analyzing

8.	(i) Demonstrate the main idea of a discrete memoryless channel, including its matrix representation with transition probabilities. (ii) Explain the concept of Binary symmetric channel with Binary communication channel.	(8) (8)	CO1	BTL 3	Applying
9.	A source "S" emits a symbols S1, S2 and S3 with probabilities of 0.25, 0.5 and 0.25. Calculate self-information and Entropy of a source S.	(16)	CO1	BTL 3	Applying
10.	Derive the expression for channel capacity of a continuous channel. Comment on the trade-off between SNR and capacity.	(16)	CO1	BTL 3	Applying
11.	A voice grade telephone channel has a bandwidth of 3400 Hz. Calculate channel capacity of the telephone channel for a SNR of 30 dB and estimate minimum SNR required to support a rate of 4.8 kbps.	(16)	CO1	BTL 4	Analyzing
12.	A source generates five messages m_0, m_1, m_2, m_3 and m_4 with probabilities 0.55,0.15,0.15,0.10 and 0.05 respectively. The successive messages emitted by the source are statistically independent. Determine the code words for the messages and efficiency using Shannon Fano Algorithm.	(16)	CO1	BTL 3	Applying
13.	Five symbols of the alphabet of discrete memory less source and their probabilities are given as {S_1, S_2, S_3, S_4, S_5) and {0.4,0.14,0.16,0.15,0.15}. Construct using Shannon fano Coding and calculate the code efficiency.	(16)	CO1	BTL 4	Analyzing
14.	(i) Calculate the Huffman code for a discrete memoryless source with probability statistics {0.1,0.1,0.2,0.2,0.4}. (ii) Identify the drawbacks of Huffman coding.	(12) (4)	CO1	BTL 3	Applying
15.	The source of information A generates the symbols {A1, A2, A3, A4, A5, A6} with the corresponding probabilities {0.2,0.3,0.11,0.16,0.18,0.05}. Explain the code for source	(16)	CO1	BTL 3	Applying

	symbols using Huffman and Shannon- Fano encoder and compare its efficiency.				
16.	Four symbols of the alphabet of discrete memory less source and their probabilities are given as $\{S_1, S_2, S_3, S_4\}$ and $\{1/3, 1/6, 1/4, 1/4\}$. Explain the code for source symbols using Huffman and Shannon- Fano encoder and compare its efficiency.	(16)	CO1	BTL 4	Analyzing
17.	Five sources messages are probable to appear as symbols $\{m1, m2, m3, m4, m5\}$ with the corresponding probabilities $\{0.4, 0.15, 0.15, 0.15, 0.15\}$. Find the code for source symbols using Huffman and Shannon-Fano encoder and compare its efficiency.	(16)	CO1	BTL 4	Analyzing

UNIT II WAVEFORM CODING AND REPRESENTATION				
Prediction filtering, Linear Predictive Coding, PCM, DPCM, Delta Modulation & ADM principles, Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ – Manchester				
PART A				
Q.No	Questions	CO	BT Level	Competence
1.	What is linear predictor? On what basis are predictor coefficients are determined.	CO2	BTL1	Remembering
2.	Why Prediction filtering is required?	CO2	BTL2	Understanding
3.	State the properties of linear prediction.	CO2	BTL 1	Remembering
4.	What are the disadvantages of DPCM?	CO2	BTL 1	Remembering
5.	Outline the principle of DM.	CO2	BTL 2	Understanding
6.	Write the advantages of delta modulator.	CO2	BTL 2	Understanding
7.	Name the techniques to overcome slope overload and granular noise in delta modulation system.	CO2	BTL1	Remembering
8.	Why delta modulation is superior to differential pulse code modulation?	CO2	BTL 1	Remembering

9.	State the concept of PCM.		CO2	BTL1	Remembering
10.	List any four speech encoding methods.		CO2	BTL 1	Remembering
11.	What is meant by temporal waveform coding?		CO2	BTL 1	Remembering
12.	List the drawbacks of ADM.		CO2	BTL 1	Remembering
13.	Compare PCM and DPCM.		CO2	BTL 1	Remembering
14.	Distinguish DM and ADM.		CO2	BTL 2	Understanding
15.	Mention the concept of quantization.		CO2	BTL 1	Remembering
16.	Predict the principle of linear predictive coder.		CO2	BTL 2	Understanding
17.	Sketch the model of LPC.		CO2	BTL 1	Remembering
18.	Summarize the need of line codes.		CO2	BTL 2	Understanding
19.	Mention the properties of line coding.		CO2	BTL 1	Remembering
20.	Represent unipolar and RZ code for the binary data 01101001.		CO2	BTL 2	Understanding
21.	Draw the power spectral density for Bipolar NRZ format.		CO2	BTL 1	Remembering
22.	What is Manchester coding?		CO2	BTL 1	Remembering
23.	Express the data 10011 using the Manchester code format.		CO2	BTL 2	Understanding
24.	Find the SNR of PCM system if number of quantization levels is 2^8?		CO2	BTL 2	Understanding
PART B					
1.	(i) With the block diagram explain in detail about the speech generation model.	(8)	CO2	BTL 4	Analyzing
	(ii) Assess the process of LPC encoder and decoder.	(8)			
2.	(i) In a binary PCM system, the output signal to quantization noise ratio is to be minimum of 40 dB. Determine the number of required levels and find the corresponding output signal to quantization noise ratio.	(8)	CO2	BTL 4	Analyzing
	(ii) A binary channel with bit rate 36,000 bits/sec is available for PCM voice transmission. Find number of bits per sample, number of quantization levels and sampling frequency assuming highest frequency component of voice signal is 3.2 kHz.	(8)			

3.	Demonstrate DPCM system transmitter and receiver with suitable diagrams.	(16)	CO2	BTL 3	Applying
4.	Summarize delta modulation transmitter and receiver with their block diagrams.	(16)	CO2	BTL 4	Analyzing
5.	A signal having bandwidth of 3 kHz is to be encoded using 8 bit PCM and DM system. If 10 cycles of signal are digitized, state how many bits will be digitized in each case if sampling frequency is 10 kHz? Also find bandwidth required in each case.	(16)	CO2	BTL 3	Applying
6.	A 1 kHz signal of voice channel is sampled at 4 kHz using 12 bit PCM and a DM system. If 25 cycles of voice signal are digitized. Calculate the Signaling rate, required bandwidth and number of bits required to be transmitted.	(16)	CO2	BTL 4	Analyzing
7.	In a single integration DM scheme, the voice signal is sampled at a rate of 64 kHz, the maximum signal amplitude is 1 volt, voice signal bandwidth is 3.5 kHz. (a)Determine the minimum value of step size to avoid slope overload. (b)Evaluate the granular noise N_O. (c)Assuming the signal to be sinusoidal, calculate the signal power and signal to noise ratio.	(6) (5) (5)	CO2	BTL 4	Analyzing
8.	State and explain the functioning of PCM system with neat block diagrams.	(16)	CO2	BTL 3	Applying
9.	Explain ADM with transmitter and receiver block diagrams	(16)	CO2	BTL 3	Applying
10.	Explain about the linear prediction with necessary equations.	(16)	CO2	BTL 4	Analyzing
11.	(i) Write down the properties of linear prediction. (ii)Compare source coding methods with various parameters.	(8) (8)	CO2	BTL 3	Applying

12.	Briefly explain the properties of line coding.	(16)	CO2	BTL 3	Applying
13.	What is the need for line coding of signals? Explain on the power spectral properties of different line coding signals.	(16)	CO2	BTL 3	Applying
14.	(i) A DM system is designed to operate at 3 times the Nyquist rate for a signal with 3 kHz bandwidth. The quantizing step size is 250 mV. (ii) Determine the maximum amplitude of a 1 kHz input sinusoid for which delta modulator does not show slope overload. Evaluate the post filtered output SNR for the signal.	(8) (8)	CO2	BTL 4	Analyzing
15.	For the following bit sequence1101010011draw the waveforms for RZ unipolar, NRZ polar, Manchester, RZ polar and NRZ line coding techniques.	(16)	CO2	BTL 4	Analyzing
16.	For the sequence 11001001 sketch the waveforms for RZ unipolar, NRZ polar, Manchester, RZ polar and NRZ line coding techniques.	(16)	CO2	BTL 3	Applying
17.	Compare the various line coding techniques with necessary diagrams.	(16)	CO2	BTL 4	Analyzing

UNIT III BASEBAND TRANSMISSION AND RECEPTION				
ISI – Nyquist criterion for distortion less transmission – Raised cosine spectrum – Correlative coding – Eye pattern – Receiving Filters - Matched Filter, Correlation receiver.				
PART A				
Q.No	Questions	CO	BT Level	Competence
1.	What are the causes for ISI in Communication System?	CO3	BTL 1	Remembering
2.	Why 'ISI cannot be avoided'?	CO3	BTL 1	Remembering
3.	Propose a method to minimize ISI in communication system.	CO3	BTL 1	Remembering

4.	What is an ideal Nyquist channel?	CO3	BTL 1	Remembering
5.	List the practical difficulties of ideal Nyquist channel.	CO3	BTL 1	Remembering
6.	Summarize the Nyquist criteria for distortion less baseband transmission	CO3	BTL 2	Understanding
7.	Compare Nyquist second and third criteria to realize zero ISI.	CO3	BTL 1	Remembering
8.	Outline the concept behind the raised cosine spectrum.	CO3	BTL 2	Understanding
9.	Define roll off factor.	CO3	BTL 1	Remembering
10.	The output of a digital computer is at a rate of 64 kbps. If the roll off factor $\alpha = 0.5$, Choose the bandwidth required to transmit the data in each case.	CO3	BTL 2	Understanding
11.	How does pulse shaping reduce ISI?	CO3	BTL 2	Understanding
12.	A TDM signal with bit time of 0.5µs is to be transmitted using a channel with raised cosine roll off factor of 0.5. what is the bandwidth required?	CO3	BTL 1	Remembering
13.	Define correlative coding.	CO3	BTL 1	Remembering
14.	Draw the frequency response of duo binary conversion filter.	CO3	BTL 1	Remembering
15.	Mention the drawbacks of duo binary system.	CO3	BTL 1	Remembering
16.	Mention the need of precoding in a duobinary scheme.	CO3	BTL 2	Understanding
17.	Draw the block diagram of modified duobinary encoder with precoder.	CO3	BTL 1	Remembering
18.	How the width and height of the eye pattern reflect the performance of a communication system.	CO3	BTL 3	Understanding
19.	Identify and label the key components of an Eye pattern with diagram.	CO3	BTL 1	Remembering
20.	Outline the features of a matched filter.	CO3	BTL 2	Understanding
21.	When does the matched filter is called as integrate and dump filter?	CO3	BTL 2	Understanding
22.	Compare the matched filter and correlation receiver.	CO3	BTL 2	Understanding

23.	State the assumptions based on which the average probability of the symbol error can be minimized.		CO3	BTL 1	Remembering
24.	What is the use of eye pattern?		CO3	BTL 1	Remembering
PART B					
1.	Elaborate how ISI occurs in base-band binary data transmission system.	(16)	CO3	BTL 4	Analyzing
2.	Analyze different methods to remove Inter symbol Interference (ISI). Evaluate the Nyquist first criterion for achieving Zero ISI in communication systems	(16)	CO3	BTL 4	Analyzing
3.	(i) Summarize the benefits of Nyquist pulse shaping. (ii) Explain the information provided in eye diagram.	(8) (8)	CO3	BTL 3	Applying
4.	Apply the Nyquist criterion to explain how it effectively eliminates interference in distortion less baseband binary communication systems under ideal conditions.	(16)	CO3	BTL 3	Applying
5.	Illustrate "raised cosine spectrum". Explain how it helps to avoid ISI.	(16)	CO3	BTL 3	Applying
6.	Categorize the M-ary baseband system and explain in detail with an example.	(16)	CO3	BTL 4	Analyzing
7.	Examine the principle of obtaining eye pattern and mark important observations made from the eye pattern.	(16)	CO3	BTL 4	Analyzing
8.	Explain how eye pattern illustrates the performance of data transmission system with respect to Inter Symbol Interference with neat sketch.	(16)	CO3	BTL 3	Applying
9.	Illustrate the basic idea of correlative coding with a specific example.	(16)	CO3	BTL 3	Analyzing
10.	(i) Analyze the differential encoder with neat block diagram. (ii) Identify the merits and demerits of Duo binary signaling.	(8) (8)	CO3	BTL 4	Analyzing

11.	Describe the modified Duo binary coding technique and its performance by illustrating its frequency and impulse response.	(16)	CO3	BTL 3	Applying
12.	(i) Draw the simple duo-binary encoder without precoder and explain in detail. (ii) Explain the frequency response of duo-binary encoding scheme.	(8) (8)	CO3	BTL 3	Applying
13.	(i) Draw the sub systems of a correlation receiver and explain in detail. (ii) Write about an optimum receiver based on the matched filter with an appropriate block diagram	(8) (8)	CO3	BTL 3	Applying
14.	(i) Illustrate the concept of Matched filter receiver. (ii) Determine the principle of signal reception using a correlator type receiver.	(16)	CO3	BTL 3	Applying
15.	Deduce the expression for the maximum signal to noise ratio of a matched filter.	(16)	CO3	BTL 3	Applying
16.	Analyze the effectiveness of correlative coding in eliminating Intersymbol Interference (ISI) in communication systems	(16)	CO3	BTL 4	Analyzing
17.	Consider the input binary sequence 0010110 to a precoded duobinary scheme and explain the process of generating original binary sequence with the necessary diagram.	(16)	CO3	BTL 4	Analyzing

UNIT IV – DIGITAL MODULATION SCHEME				
Gram-Schmidt orthogonalization procedure, ASK, FSK, BPSK, QPSK, QAM – Generation, detection, PSD & BER of coherent system and Non-Coherent Systems.				
PART A				
Q.No	Questions	CO	BT Level	Competence
1.	Outline the need for geometric representation of signals.	CO4	BTL 2	Understanding
2.	What is meant by coherent ASK?	CO4	BTL 1	Remembering
3.	Draw the block diagram of a coherent BFSK receiver.	CO4	BTL 1	Remembering

4.	What is the decision rule for BFSK?	CO4	BTL 1	Remembering
5.	Identify the difference between BPSK and QPSK techniques.	CO4	BTL 2	Understanding
6.	What is QPSK? Write down the expression for the QPSK signal.	CO4	BTL 2	Understanding
7.	Sketch the BER curve for ASK, FSK and BPSK digital modulation schemes.	CO4	BTL 1	Remembering
8.	How to improve the Bit Error Rate of a system?	CO5	BTL 1	Remembering
9.	A BFSK signal operated with a carrier frequency of 140MHz, modulated by data bits at a rate of 2400 bits/sec. what is the bandwidth requirement?	CO4	BTL 2	Understanding
10.	A BPSK system makes errors at the average rate of 100 errors per day. Data rate is 1 kbps. The single-sided noise power spectral density is 10 W/Hz. Assume the system to be wide sense stationary, obtain the average bit error probability.	CO5	BTL 2	Understanding
11.	Compare coherent and non-coherent reception.	CO4	BTL 2	Understanding
12.	Distinguish the error probability for BPSK and QPSK.	CO5	BTL 2	Understanding
13.	Summarize the features of DPSK.	CO4	BTL 2	Understanding
14.	Indicate why PSK always preferable over ASK in Coherent detection.	CO4	BTL 2	Understanding
15.	What are the special features of QAM?	CO4	BTL 1	Remembering
16.	Draw the signal space diagram for QAM signal for M=8.	CO4	BTL 2	Understanding
17.	Write about the signal constellation diagram.	CO4	BTL 1	Remembering
18.	What are the advantages of QPSK over PSK?	CO4	BTL 1	Remembering
19.	When the non-coherent receiver is preferred?	CO4	BTL 2	Understanding
20.	State the principle of Differential Phase Shift Keying.	CO4	BTL 1	Remembering
21.	Write down the error probability of DPSK in terms of E_b/N_o.	CO5	BTL 2	Understanding

22.	A binary frequency shift keying system employs two signaling frequencies f_1 and f_2. The lower frequency f_1 is 1200 Hz and signaling rate is 500 baud. Calculate f_2.		CO4	BTL 2	Understanding
23.	Differentiate between baseband transmission and passband transmission.		CO4	BTL 2	Understanding
24.	Define the concept of spectral efficiency.		CO4	BTL 1	Remembering
PART B					
1.	(i) Define basis set. In what way it is useful in representing the signal. (ii) With an example explain how the basis set is determined by Gram Schmidt procedure.	(8) (8)	CO4	BTL 3	Applying
2.	(i) Explain about digital modulation schemes. (ii) Elaborate the geometrical representation of signal and explain in detail for BPSK signal.	(8) (8)	CO4	BTL 4	Analyzing
3.	A Bandpass transmission uses a signaling scheme with $x_1(t) = -A\cos 2\pi f_0 t$ $x_2(t) = A\cos 2\pi f_0 t$, $0\leq t \leq T_b$ where the bit duration is 0.2ms and $f_0 = 5f_b$. The carrier amplitude at the receiver is 1 mV and the PSD of AWGN is 10^{-11} W/Hz. Assume that ideal correlation receiver is used. Calculate the probability of bit error for the given signaling scheme.	(16)	CO5	BTL 3	Applying
4.	Describe the coherent detection of FSK signal and derive the expression for the probability of error.	(16)	CO5	BTL 3	Applying
5.	Draw the transmitter, receiver block diagram of QPSK and explain its signal space diagram in detail.	(16)	CO4	BTL 3	Applying
6.	In a QPSK system, the bit rate of NRZ stream is 10 Mbps and carrier frequency is 1GHz. Determine the symbol rate of transmission and bandwidth requirement of the channel.	(16)	CO4	BTL 4	Analyzing

7.	Identify the principle of DPSK? Explain the transmitter and receiver of DPSK scheme.	(16)	CO4	BTL 3	Applying
8.	(i) Distinguish how QAM differs from QPSK, explain in detail.	(8)	CO5	BTL 4	Analyzing
	(ii) Analyze the error performance of coherent detection QAM system	(8)			
9.	With neat block diagram explain the transmitter and receiver of a QAM signal.	(16)	CO4	BTL 4	Analyzing
10.	Explain the power spectral density and bandwidth of QAM signal with neat diagrams and mention its advantages.	(16)	CO4	BTL 4	Analyzing
11.	(i) Sketch the constellation diagram of QPSK scheme and explain.	(8)	CO5	BTL 4	Analyzing
	(ii) Obtain the expression for bit error probability of QPSK system.	(8)			
12.	(i) Compare the BER of coherent PSK, coherent QPSK and coherent FSK.	(8)	CO5	BTL 4	Analyzing
	(ii) Summarize the features of the non-coherent receivers.	(8)			
13.	A set of binary data is sent at the rate of R_b= 100 Kbps over a channel with 60 dB transmission loss and power spectral density η = 10^{-12} W/Hz at the receiver. Evaluating the transmitted power for a bit error probability P_e= 10^{-3} for the following modulation schemes. (a) FSK (b) PSK (c) DPSK (d) 16 QAM	(16)	CO5	BTL 4	Analyzing
14.	Draw the signal space diagram of a coherent QPSK modulation scheme and also find the probability of error if the carrier takes on one of four equally spaced values at $0°, 90°, 180°$ and $270°$.	(16)	CO5	BTL 3	Applying
15.	In digital CW communication system, the bit rate of NRZ data stream in 1 Mbps and carrier frequency is 100 MHz. Solve for the symbol rate of transmission and bandwidth requirement of the channel in the following cases of different techniques used. (a) BPSK system (b) QPSK system (c) 16-ary PSK system	(16)	CO4	BTL 3	Applying

(b)	Determine the average probability of error and Euclidean distance of BPSK and BFSK and compare the values. Consider the following parameters: Data rate: 2.5 Mbps PSD of AWGN ($N_O/2$): 10^{-20} W/Hz Received carrier amplitude: 1µV	(16)	CO5	BTL 4	Analyzing
(c)	Describe the process of generation and detection of a coherent binary PSK signal and derive the power spectral density of binary PSK signal and plot it.	(16)	CO4	BTL 3	Applying

UNIT V - ERROR CONTROL CODING

Channel coding theorem – Linear Block codes – Hamming codes – Cyclic codes – Convolutional codes – Viterbi Decoder.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	State Channel Coding Theorem and its need.	CO6	BTL 1	Remembering
2.	Mention the need for error control codes.	CO6	BTL 2	Understanding
3.	List the applications of error correction codes.	CO6	BTL 1	Remembering
4.	Outline the features of linear code.	CO6	BTL 2	Understanding
5.	Define code rate of a block code.	CO6	BTL 1	Remembering
6.	Mention the significance of minimum distance of a block code.	CO6	BTL 2	Understanding
7.	Express the syndrome properties of linear block code.	CO6	BTL 2	Understanding
8.	Distinguish Hamming Distance.	CO6	BTL 1	Remembering
9.	Deduce the Hamming distance between 101010 and 010101. If the minimum Hamming distance of a (n, k) linear block code is 3, what is the minimum Hamming weight?	CO6	BTL 2	Understanding
10.	What are the advantages and disadvantages of Hamming codes.	CO6	BTL 1	Remembering
11.	List the properties of Cyclic codes.	CO6	BTL 2	Understanding

12.	Summarize the systematic code word with its structure.	CO6	BTL 2	Understanding
13.	List the properties of Generator polynomial.	CO6	BTL 2	Understanding
14.	When does a binary code is said to be cyclic codes?	CO6	BTL 1	Remembering
15.	Write the generator polynomial of a cyclic codes. part	CO6	BTL 1	Remembering
16.	Generate the cyclic code for (n, k) syndrome calculator.	CO6	BTL 2	Understanding
17.	The code vector [1110010] is sent, the received vector is [1100010]. Calculate the Syndrome.	CO6	BTL 1	Remembering
18.	What is meant by constraint length of a convolutional encoder?	CO6	BTL 1	Remembering
19.	Compute the code rate of a convolutional encoder with 'n' modulo 2 adders, 'm' flip flops and 'L' input bits.	CO6	BTL 2	Understanding
20.	Define convolutional code. How is it different from block codes?	CO6	BTL 2	Remembering
21.	Mention the drawback of code tree approach in convolutional codes.	CO6	BTL 2	Understanding
22.	Outline the techniques/algorithms used in encoding and decoding of Convolutional code.	CO6	BTL 1	Remembering
23.	What are the approaches to identify the output sequence in a convolutional encoder.	CO6	BTL 1	Remembering
24.	How Trellis diagram is used to represent the code generated by convolutional coder and mention its advantages.	CO6	BTL 2	Understanding

PART B

1.	Consider the (7,4) linear block code with generator matrix $$\begin{bmatrix} 1000:101 \\ 0100:111 \\ 0010:110 \\ 0001:011 \end{bmatrix}$$ (i) Find all the code vectors. (ii) Find parity check matrix. (iii) Minimum weight of this code.	(5) (5) (6)	CO6	BTL 3	Applying

2.	For a systematic (6, 3) linear block code, P = $\begin{bmatrix} 101 \\ 011 \\ 110 \end{bmatrix}$. Analyze all the possible code vectors.	(16)	CO6	BTL 4	Analyzing
3.	Explain syndrome decoding and explain its property with appropriate example.	(16)	CO6	BTL 3	Applying
4.	Assume that the code word C=10110 for the (6,3) case is transmitted and the vector R=001110 is received. Show how a decoder using the syndrome lookup table can correct the error. Let the generator matrix as G= $\begin{bmatrix} 110100 \\ 011010 \\ 101001 \end{bmatrix}$	(16)	CO6	BTL 4	Analyzing
5.	An error control code has the following parity check matrix H= $\begin{bmatrix} 101100 \\ 110010 \\ 011001 \end{bmatrix}$ (i) What is the generator matrix G? (ii) Find the code word that begins with 101… (iii) Decode the received code word 110110. Comment on error correction and detection capability of this code.	(5) (5) (6)	CO6	BTL 4	Analyzing
6.	For a systematic (6,3) linear block code G= $\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$, (i) Solve for all the code vectors (ii) Draw encoder circuit for the above code (iii) Predict minimum hamming weight	(5) (5) (6)	CO6	BTL 3	Applying
7.	For a systematic linear block code, the three parity check digits P_1, P_2, P_3 are given by $P_{k,n-k}$ = $\begin{bmatrix} 101 \\ 111 \\ 110 \\ 011 \end{bmatrix}$ (i) Construct generated matrix. (ii) Assess the t code generated by the matrix. (iii) Determine error correcting capacity.	(16)	CO6	BTL 3	Applying

	(iv) Decode the received words with an example.				
8.	Find a generator polynomial for a (7,4) cyclic code and find the code word for [1 0 0 0].	(16)	CO6	BTL 4	Analyzing
9.	Describe the cyclic codes with the linear and cyclic property. Also represent the cyclic property of a code word in polynomial notation.	(16)	CO6	BTL 3	Applying
10.	Find the (7,4) systematic and non-systematic cyclic code words of the message word 1101.Assume the generator polynomial as $1+x^2+x^3$	(16)	CO6	BTL 4	Analyzing
11.	Analyse how to generate the output sequence from a convolutional encoder using the time domain approach and transfer domain approach.	(16)	CO6	BTL 3	Applying
12.	Draw the diagram of the ½ rate convolutional encoder with generator polynomials $G^1(D)=1+D$ $G^2(D)=1+D+D^2$ Compute the encoder output for input sequence 101101.	(16)	CO6	BTL 3	Applying
13.	Construct a convolutional Encoder with the following specifications: Constraint length =3, Code rate =1/2, Generator sequence are $g^{(1)}$ =[1 0 1] , $g^{(2)}$ =[1 1 0] , input sequence =[1 0 0 1 1].Determine the output sequence using Code Tree approach.	(16)	CO6	BTL 4	Analyzing
14.	A convolutional code is described by the following generator sequences, $g^{(1)}$= {1,0,1}, $g^{(2)}$= {1,0,0}, $g^{(3)}$= {1,1,1}. (i) Draw the encoder to this code (ii) Draw the state diagram (iii) If the message sequence is 10110, Frame the code word.	(5) (5) (6)	CO6	BTL 4	Analyzing
15.	A convolutional code is described by g1=[1 0 0], g2=[1 1 1], g3=[1 0 1] (i) Design the encoder corresponding to the code.	(5)	CO6	BTL 3	Applying

	(ii) Sketch the code tree and state diagram for this code.	(6)			
	(iii) Draw the trellis diagram.	(5)			
16.	Determine how Viterbi decoding algorithm is used for convolutional code.	(16)	CO6	BTL 4	Analyzing
17.	Sketch the state diagram of rate ½ convolutional encoder given in the figure below.	(16)	CO6	BTL 3	Applying