EC8501 – 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	BT Level	Competence
1.	What is entropy and give its mathematical equation.	BTL 1	Remembering
2.	Define source coding. State the significance of source coding	BTL 1	Remembering
3.	What is BSC?	BTL 1	Remembering
4.	Why is Huffman code called as minimum redundancy code?	BTL 2	Understanding
5.	An event has six possible outcomes with probabilities {1/2, 1/4, 1/8, 1/16, 1/32, 1/32}. Solve for the entropy of the system.	BTL 3	Applying
6.	Outline the concept of discrete memoryless source.	BTL 1	Remembering
7.	Calculate the amount of information if p_k =1/4.	BTL 3	Applying
8.	Identify the properties of entropy	BTL 1	Remembering
9.	Describe information rate?	BTL 2	Understanding
10.	Interpret the theory of mutual information	BTL 3	Applying
11.	Describe the concept of discrete memoryless channel	BTL6	Creating
12.	List out the properties of Hamming distance.	BTL 4	Analyzing
13.	Evaluate the Hamming distance between the following code words C_1={1,0,0,0,1,1,1} and C_2={0,0,0,1,0,1,1}.	BTL 5	Evaluating
14.	State the properties of mutual information	BTL 1	Remembering
15.	Examine the types of discrete memoryless channel	BTL 4	Analyzing
16.	Give the main idea of Channel Capacity	BTL 2	Understanding
17.	Summarizeshannon's law	BTL 2	Understanding
18.	Formulate the steps involved in Shannon Fano coding	BTL 6	Creating

19.	Distinguish the various source coding techniques.	**BTL 4**	**Analyzing**
20.	Revise the steps involved in Huffman coding	**BTL 5**	**Evaluating**

	PART –B			
1.	Enumerate Shannon's Fano algorithm and Huffman coding with a suitable example.	(13)	**BTL 1**	**Remembering**
2.	Five symbols of the alphabet of discrete memory less source and their probabilities are given below, S={S0, S1,S2,S3,S4) P(S)={0.4,0.19,0.16,0.15,0.15}. Predict the symbols using Huffman coding and calculate the average codeword length and efficiency.	(13)	**BTL 2**	**Understanding**
3.	Illustrate the following with equations (i) Uncertainity (ii) Information (iii) Entropy and it's properties	(6) (3) (4)	**BTL 3**	**Applying**
4.	(i) Infer Hamming codes. Analyse the conditions which hamming codes has to satisfy. (ii) Examine the following terms - Code efficiency, Channel data rate and code rate.	(13)	**BTL 4**	**Analyzing**
5.	Five symbols of the alphabet of discrete memory less source and their probabilities are given below, S={S0, S1,S2,S3,S4) P(S)={0.4,0.19,0.16,0.15,0.15}. Point out the symbols using Shannon Fano coding and calculate the average codeword length and efficiency	(13)	**BTL 4**	**Analyzing**
6.	(i) Summarize Source Coding with block diagram and mention it's functional requirements. (ii) Deduce the equations for average codeword length and coding efficiency using entropy.	(13)	**BTL 5**	**Evaluating**
7.	(i) Give the main idea of discrete memoryless channel and it's matrix form involving transition probabilities. (ii) Relate the concept of Binary symmetric channel with Binary communication channel & Binary erasure channel	(13)	**BTL 2**	**Understanding**
8.	Interpret the following (i) Mutual information and its properties. (ii) Channel capacity and it's equation.	(13)	**BTL 3**	**Applying**
9.	Five symbols of the alphabet of discrete memory less source and their probabilities are given below, S={S0, S1,S2,S3,S4) P(S)={0.4,0.2,0.2,0.1,0.1}. Construct the symbols using Huffman	(13)	**BTL 6**	**Creating**

	coding and calculate the average codeword length and efficiency.			
10.	(i) Brief the properties of entropy. (ii) Describe the BSC and BEC with their channel diagram and transition matrix.	(6) (7)	**BTL 1**	**Remembering**
11.	Five symbols of the alphabet of discrete memory less source and their probabilities are given below, S={S0, S1,S2,S3,S4) P(S)={0.4,0.2,0.2,0.1,0.1}. Show the symbols using Shannon Fano Coding and calculate the average codeword length and efficiency.	(13)	**BTL 1**	**Remembering**
12.	A telephone channel has a bandwidth of 3 kHz . (i) Predict channel capacity of the telephone channel for a SNR of 20 dB (ii) Estimate minimum SNR required to support a rate of 5 kbps.	(13)	**BTL 2**	**Understanding**
13.	Reproduceshannon's 3 laws that govern the Information theory	(13)	**BTL 1**	**Remembering**
14.	A telephone channel has a bandwidth of 3 kHz and output SNR of 20 dB. The source has a total of 512 symbols and the occurrence of all symbols are equiprobable. Point out the following (i) channel capacity (ii) Information content per symbol. (iii) maximum symbol rate for which error free transmission is possible.	(13)	**BTL 4**	**Analyzing**

	PART – C			
1	The source of information A generates the symbols {A0, A1, A2, A3& A4} with the corresponding probabilities {0.4, 0.3, 0.15, 0.1 and 0.05}. Evaluate the code for source symbols using Huffman and Shannon-Fano encoder and compare its efficiency.	(15)	**BTL 5**	**Evaluating**
2	Draw the block diagram of Digital Communication system and Construct each of it's components.	(15)	**BTL 6**	**Creating**
3	Propose the following with suitable diagrams and equations. (i) Discrete memoryless source (ii) Discrete memoryless channel	(15)	**BTL 6**	**Creating**
4	The source of information A generates the symbols {A0, A1, A2, A3 , A4 , A5} with the corresponding probabilities {0.45, 0.41, 0.4, 0.3 , 0.29 and 0.05}. Evaluate the code for source symbols using Huffman and Shannon-Fano encoder and compare its efficiency.	(15)	**BTL 5**	**Evaluating**

UNIT II - WAVEFORM CODING & REPRESENTATION

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ – Manchester

PART A

Q.No	Questions	BT Level	Competence
1.	What is linear predictor? On what basis are predictor coefficients are determined.	BTL 1	Remembering
2.	Identify the need of prediction filtering.	BTL 1	Remembering
3.	List the 2 properties of linear prediction.	BTL 1	Remembering
4.	Summarize the need of Line Codes.	BTL 2	Understanding
5.	Why Delta Modulation is superior to Differential Pulse Code Modulation?	BTL 1	Remembering
6.	Express the data 10011 using the Manchester code format.	BTL 2	Understanding
7.	Discuss about delta modulation and its limitations.	BTL 2	Understanding
8.	Demonstrate the techniques to overcome slope overload and granular noise in delta modulation system.	BTL 2	Understanding
9.	Interpret the principle of DM and ADM.	BTL 3	Applying
10.	Illustrate the difference betweenDM and ADM.	BTL 3	Applying
11.	Point out the slope overload distortion in delta modulation systems.	BTL 4	Analyzing
12.	Recall the advantages of delta modulator.	BTL 1	Remembering
13.	Inspect the concept ofADPCM.	BTL 4	Analyzing
14.	Outline the theory ofAPB and APF.	BTL 4	Analyzing
15.	Show the properties of line coding.	BTL 3	Applying
16.	Recall Manchester coding.	BTL 1	Remembering
17.	Assess the principle of linear predictive coder .	BTL 5	Evaluating
18.	Summarize theapplications of LPC.	BTL 5	Evaluating
19.	Formulate the model of LPC.	BTL 6	Creating
20.	Construct unipolar and RZ code for the binary data 01101001.	BTL 6	Creating

	PART –B			
1.	(i) Evaluate the structure of linear predictor. (ii) Assess the process of prediction error.	(7) (6)	**BTL 5**	**Evaluating**
2.	(i) Summarize adaptive delta modulator with continuously variable step size and explain with block diagram. (ii) Explain the difference between PCM systems and delta modulation systems.	(7) (6)	**BTL 2**	**Understanding**
3.	(i) How would you explain delta modulation and its quantization error? (ii) Explain how adaptive delta modulation performs better than gains more SNR than delta modulation.	(7) (6)	**BTL 1**	**Remembering**
4.	Describe delta modulation system in detail with a neat block diagram. Also illustrate two forms of quantization error in delta modulation.	(13)	**BTL 1**	**Remembering**
5.	Construct a DPCM system. Derive the expression for slope overload noise Of the system.	(13)	**BTL 3**	**Applying**
6.	(i) State in your own words the functioning of ADPCM system with block diagram. (ii) A delta modulator with a fixed step size of 0.75v is given a sinusoidal message signal. If the sampling frequency is 30 times the Nyquist rate, what is the best maximum permissible amplitude of the message signal if slope overload is to be avoided?	(7) (6)	**BTL 2**	**Understanding**
7.	How would you show your understanding of (i) Adaptive quantization schemes (ii) Adaptive prediction schemes.	(7) (6)	**BTL 3**	**Applying**
8.	A signal having bandwidth of 3kHz 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.	(13)	**BTL 6**	**Creating**
9.	Write the comparison of various line coding techniques and list their merits and demerits.	(13)	**BTL 1**	**Remembering**
10.	Recall the need for line shaping of signals. Derive the PSD of an unipolar BZ and NRZ, line code and compare their performance.	(13)	**BTL 1**	**Remembering**
11.	What is the function of LPC model and explain with diagrams.	(13)	**BTL 4**	**Analyzing**
12.	Illustrate and explain the properties of line codes.	(13)	**BTL 2**	**Understanding**

13.	Examine the power spectral density of NRZ bipolar and unipolar data format assume that 1s and 0s of input binary data occur with equal probability.	(13)	**BTL 4**	**Analyzing**
14.	How would you classify the various types of speech encoding techniques?	(13)	**BTL 4**	**Analyzing**

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	PART-C			
1	A television signal with a bandwidth of 4.2 MHz is transmitted using binary PCM. The number of quantization level is 512. Calculate (i) determine the code word length and transmission bandwidth (ii) Can you find Final bit rate and Output signal to quantization noise ratio.	(8) (7)	**BTL 5**	**Evaluating**
2	In a single integration DM scheme the voice signal is sampled at a rate of 64 kHz, the maximum signal amplitude is 1v, voice signal bandwidth is 3.5 kHz . (i) Determine the minimum value of step size to avoid slope overload (ii) Determine the granular noise N_o. (iii) Assuming the signal to be sinusoidal, calculate the signal power and signal to noise ratio.	(5) (5) (5)	**BTL 5**	**Evaluating**
3	A 1 kHz signal of voice channel is sampled at 4kHz using 12 bit PCM and a DM system. If 25 cycles of voice signal are digitized. Solve in each case (i) Signaling rate (ii)Bandwidth required (iii) No of bits required to be transmitted.	(5) (5) (5)	**BTL 6**	**Creating**
4	For the sequence 10111001, Develop the waveform supporting the following data formats. (i) Unipolar RZ (ii) Polar NRZ (iii) Alternate mark inversion (iv) Manchester coding. Draw the corresponding spectrum of the above formats and explain.	(15)	**BTL 6**	**Creating**

UNIT III - BASEBAND TRANSMISSION& RECEPTION

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding – Eyepattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization

PART A

Q.No	Questions	BT Level	Competence
1.	Give the practical difficulties of ideal nyquist channel.	BTL 2	Understanding
2.	Summarize the raised cosine spectrum.	BTL 2	Understanding
3.	Define roll off factor.	BTL 1	Remembering
4.	Describe the full cosine roll off characteristics.	BTL 2	Understanding
5.	What is meant by ISI in communication system? How it can be minimized?	BTL 1	Remembering
6.	Show the frequency response of duo binary signal.	BTL 3	Applying
7.	Point out duo binary system. What are the drawbacks of it?	BTL 4	Analyzing
8.	State Nyquist criteria.	BTL 1	Remembering
9.	Utilize Nyquist second and third criteria to realize zero ISI.	BTL 3	Applying
10.	Discuss how pulse shaping reduce ISI.	BTL 2	Understanding
11.	List four applications of eye pattern.	BTL 1	Remembering
12.	Examine correlative level coding.	BTL 4	Analyzing
13.	Outline the causes for ISI.	BTL 1	Remembering
14.	Justify the statement ‘ISI cannot be avoided’.	BTL 5	Evaluating
15.	Compare the coherent and non-coherent receivers.	BTL 4	Analyzing
16.	Illustrate Eye pattern with diagram.	BTL 3	Applying
17.	Define Equalization.	BTL 1	Remembering
18.	Assess the need for adaptive equalization in a switched telephone network.	BTL 5	Evaluating
19.	Propose the methods used to implement adaptive equalizer.	BTL6	Creating
20.	Generalize the need for equalization filter.	BTL 6	Creating

	PART –B			
1.	Outline the modified Duo binary coding technique and its performance by illustrating its frequency and impulse response.	(13)	**BTL 1**	**Remembering**
2.	(i) Write the concept of Non Linear Decision feedback Adaptive Equalizer. (ii) Describe the adaptive equalization with block diagram.	(7) (6)	**BTL 1**	**Remembering**
3.	Derive the formula for LMS algorithm and draw the signal flow graph of LMS algorithm.	(13)	**BTL 1**	**Remembering**
4.	Illustrate "raised cosine spectrum". Discuss how does it help to avoid ISI?	(13)	**BTL 3**	**Applying**
5.	What is ISI ? List the various methods to remove ISI in s communication system. Also state and prove Nyquist first criterion for Zero ISI.	(13)	**BTL 1**	**Remembering**
6.	(i) Summarize the benefits of Nyquist pulse shaping. (ii) Predict the information provided in eye diagram.	(7) (6)	**BTL 2**	**Understanding**
7.	Discuss how Nyquist criterion eliminates interference in the absence of noise for distortion less baseband binary transmission.	(13)	**BTL 2**	**Understanding**
8.	(i) Describe any one method for ISI control. (ii) Explain the principle of signal reception using a correlator type receiver.	(7) (6)	**BTL 2**	**Understanding**
9.	(i) Interpret the pulse shaping method to minimize ISI. (ii) Demonstrate how eye pattern illustrates the performance of data transmission system with respect to Inter Symbol Interference with neat sketch.	(7) (6)	**BTL 3**	**Applying**
10.	Elaborate how ISI occurs in base-band binary data transmission system.	(13)	**BTL 6**	**Creating**
11.	Evaluate in detail about the M-ary baseband system	(13)	**BTL 5**	**Evaluating**
12.	Point out the types of Adaptive Equalizers in detail with neat diagrams	(13)	**BTL 4**	**Analyzing**
13.	(i) Analyzing adaptive MLSE equalizer with block diagrams. (ii) Identify the merits and demerits of Duo binary signaling.	(7) (6)	**BTL 4**	**Analyzing**
14.	Examine the principle of obtaining eye pattern and mark important observations made from the eye pattern.	(13)	**BTL 4**	**Analyzing**

	Part- C			
1.	Generalize the realizations of the receiving filters based on the signal correlator and matched filter.	(15)	**BTL 5**	**Evaluating**
2.	Discuss in detail about inter symbol interference (ISI) and the nyquist criterion for minimizing ISI. Elaborate the difficulties in implementing it in a practical system.	(15)	**BTL 6**	**Creating**
3.	Discuss in detail about correlative coding to eliminate ISI.	(15)	**BTL 6**	**Creating**
4.	(i) Deduce the equation for the impulse response coefficients of the zero forcing equalizer. (ii) Explain the two operation modes of adaptive equalizers.	(7) (8)	**BTL 5**	**Evaluating**

UNIT IV - DIGITAL MODULATION SCHEME

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers - Principle of DPSK.

PART A

Q.No	Questions	BT Level	Competence
1.	Outline the need for geometric representation of signals.	**BTL 2**	**Understanding**
2.	Draw the block diagram of a coherent BFSK receiver.	**BTL 1**	**Remembering**
3.	Identify the difference between BPSK and QPSK techniques.	**BTL 1**	**Remembering**
4.	What is QPSK? Write down the expression for the QPSK signal.	**BTL 1**	**Remembering**
5.	Sketch the BER curve for ASK,FSK,BPSK digital modulation schemes.	**BTL 1**	**Remembering**
6.	A BFSK system employs two signaling frequencies f1 and f2. The lower frequency f1 is 1200 Hz and signaling rate is 500 Baud. Compute f2.	**BTL 3**	**Applying**
7.	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, predict the average bit error probability.	**BTL 3**	**Applying**
8.	Compare coherent and non coherent reception.	**BTL 4**	**Analyzing**
9.	Distinguish the error probability for BPSK and QPSK.	**BTL 4**	**Analyzing**
10.	Discuss the drawbacks of ASK.	**BTL 2**	**Understanding**
11.	Indicate why PSK always preferable over ASK in Coherent detection.	**BTL 2**	**Understanding**
12.	Write the special features of QAM.	**BTL 1**	**Remembering**
13.	Reproduce the signal space diagram for QAM signal for M=8.	**BTL 1**	**Remembering**
14.	Illustrate about the constellation diagram.	**BTL 2**	**Understanding**
15.	Design a carrier synchronization using M^{th} power loop.	**BTL 6**	**Creating**
16.	Formulate the concept of memoryless modulation.	**BTL6**	**Creating**
17.	Identify the difference between coherent and non-coherent digital modulation techniques.	**BTL 3**	**Applying**
18.	Analyze the concept of spectral efficiency.	**BTL 4**	**Analyzing**
19.	Evaluate the error probability of DPSK.	**BTL 5**	**Evaluating**
20.	Assess the features of DPSK.	**BTL 5**	**Evaluating**

	PART –B			
1.	(i)What is digital modulation scheme? Derive geometrical representation of signal. (ii) Write about the geometric representation of BPSK signal and BFSK signal.	(7) (6)	**BTL 1**	**Remembering**
2.	Explain the generation and detection of a coherent binary PSK signal and derive the power spectral density of binary PSK signal and plot it.	(13)	**BTL 1**	**Remembering**
3.	Explain the non-coherent detection of FSK signal and derive the expression for the probability of error.	(13)	**BTL 2**	**Understanding**
4.	Discuss the transmitter,receiver and signal space diagram of QPSK and describe how it produces the original sequence with the minimum probability of error with neat sketch .	(13)	**BTL 2**	**Understanding**
5.	Summarize the transmitter, receiver and generation of non-coherent version of PSK with neat sketch. derive the power spectral density of binary PSK signal	(13)	**BTL 2**	**Understanding**
6.	Outline the generation and detection of a coherent ASK signal and derive the power spectral density of binary ASK signal and plot it.	(13)	**BTL 1**	**Remembering**
7.	(i) Produce the BER comparison of coherent PSK, coherent QPSK and coherent FSK. (ii) Show the difference between coherent and non-coherent scheme	(7) (6)	**BTL 3**	**Applying**
8.	(i) Illustrate Carrier Synchronization in QPSK. (ii) Calculate the BER for a Binary phase shift keying modulation from first principles.	(6) (7)	**BTL 3**	**Applying**
9.	(i) List the difference between QAM and QPSK. (ii) Describe QPSK signaling with diagrams.	(7) (6)	**BTL 1**	**Remembering**
10.	(i) Analyzing the transmitter, receiver and signal space diagram of Quadrature Amplitude Modulation. (ii) Outline the power spectral density and bandwidth of QAM signal with neat diagrams and mention its advantages.	(5) (8)	**BTL 4**	**Analyzing**
11.	(i) Analyzing the constellation diagram of QPSK scheme. (ii) Identify the error performance of coherent detection QAM system.	(7) (6)	**BTL 4**	**Analyzing**
12.	(i) Evaluate the Quadrature Receiver structure for coherent QPSK with appropriate diagram. (ii) In a QPSK system, the bit rate of NRZ stream is 10 Mbps and carrier frequency is 1GHz. Tell the symbol rate of transmission and bandwidth requirement of the channel.	(4) (9)	**BTL 5**	**Evaluating**
13.	(i) Explain the principle of working of an “early late bit synchronizer”. (ii) Develop the expression for bit error probability of QPSK system.	(8) (5)	**BTL 6**	**Creating**
14.	(i) Identify the principle of DPSK? Explain the transmitter and receiver of DPSK scheme. (ii) Point out the Probability of error for coherently detected BFSK.	(7) (6)	**BTL 4**	**Analyzing**

	PART-C			
1	(i) Explain Carrier and symbol synchronization (ii) 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	(7) (8)	**BTL 5**	**Evaluating**
2	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 0°,90°, 180° and 270°.	(15)	**BTL 5**	**Evaluating**
3	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. (i) BPSK system (ii) QPSK system (iii) 16-ary PSK system	(15)	**BTL 6**	**Creating**
4	(i) Find the error probability of BFSK system for following parameters. PSD of white noise $N_o/2 = 10^{-10}$ Watt/Hz Amplitude of carrier is , A = 1mV at receiver input. Frequency of baseband NRZ signal is f_b=1kHz. (ii) Binary data is transmitted using PSK at rate 2Mbps over RF link having bandwidth 2MHz. Find signal power required at the receiver input so that error probability is less than or equal to 10^{-4} Assume noise PSD to be 10^{-10}Watt/Hz.	(5) (10)	**BTL 6**	**Creating**

UNIT V - ERROR CONTROL CODING

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder

PART A

Q.No	Questions	BT Level	Competence
1.	State Channel Coding Theorem and its need.	**BTL -1**	**Remembering**
2.	Analyzing the need for error control codes.	**BTL -4**	**Analyzing**
3.	Outline the features of linear code.	**BTL -1**	**Remembering**
4.	Discuss the code rate of a block code.	**BTL -2**	**Understanding**
5.	Demonstrate the significance of minimum distance of a block code.	**BTL -3**	**Applying**
6.	Express the syndrome properties of linear block code.	**BTL -2**	**Understanding**
7.	Distinguish Hamming Distance and Hamming weight.	**BTL -4**	**Analyzing**
8.	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?	**BTL -5**	**Evaluating**
9.	Summarize the advantages and disadvantages of Hamming codes.	**BTL -2**	**Understanding**
10.	Discuss two properties of generator polynomial.	**BTL -2**	**Understanding**
11.	List the properties of cyclic codes.	**BTL -1**	**Remembering**

12.	Illustrate the systematic code word with its structure.	**BTL -4**	**Analyzing**
13.	When a binary code does is said to be cyclic codes?	**BTL -1**	**Remembering**
14.	Propose the generator polynomial of a cyclic codes.	**BTL -6**	**Creating**
15.	Generate the cyclic code for (n, k) syndrome calculator.	**BTL -6**	**Creating**
16.	The code vector [1110010] is sent, the received vector is [1100010]. Identify the Syndrome.	**BTL -3**	**Applying**
17.	What is meant by constraint length of a convolutional encoder?	**BTL -1**	**Remembering**
18.	What is convolutional code? How is it different from block codes?	**BTL -1**	**Remembering**
19.	Show how Trellis diagram is used to represent the code generated by convolutional coder and mention its advantages.	**BTL -3**	**Applying**
20.	Determine the various techniques/algorithms used. in encoding and decoding of convolutional code.	**BTL -5**	**Evaluating**

	PART-B			
1.	Consider a linear block code with generator matrix $\begin{bmatrix} 1&1&0&1&0&0&0 \\ 0&1&1&0&1&0&0 \\ 1&1&1&0&0&1&0 \\ 1&0&1&0&0&0&1 \end{bmatrix}$ (i) Enumerate the parity check matrix. (ii) Trace the error detecting and capability of the code. (iii) Draw the encoder and syndrome calculation circuits. (iv) Write the syndrome for the received vector r = [1 1 0 1 01 0].	(3) (3) (3) (4)	**BTL 1**	**Remembering**
2.	(i) Analyzing the generation of (n, k) block codes and audit how block codes can be used for error control. (ii) Consider a (6, 3)block code and explain how error syndrome helps in correcting a single error for a data 110.	(7) (6)	**BTL 4**	**Analyzing**
3.	(i) Cite an example and explain one decoding procedure of linear block codes. (ii) Find the (7, 4) systematic and non-systematic cyclic code words of the message word 1101. Assume the generator polynomial as $1 + x^2 + x^3$.	(8) (5)	**BTL 1**	**Remembering**
4.	(i) Describe the steps involved in the generation of linear block codes. (ii) Explain the properties of syndrome.	(7) (6)	**BTL 2**	**Understanding**
5.	Illustrate how the errors are corrected using hamming code with an example.	(13)	**BTL 2**	**Understanding**
6.	Examine that the generator polynomial of a (7, 4) cyclic code is $1+X+X^3$. Discover the correct code word transmitted if the received code word is (i) 1011011 and (ii) 1101111	(13)	**BTL 4**	**Analyzing**
7.	With suitable numerical examples, describe the cyclic codes with the linear and cyclic property and also represent the cyclic property of a code word in polynomial notation.	(13)	**BTL 1**	**Remembering**
8.	Develop the cyclic codes with the linear and cyclic property. Also represent the cyclic property of a code word in polynomial notation.	(13)	**BTL 3**	**Applying**
9.	(i) Determine how Viterbi decoding algorithm is used for convolutional code. (ii) Explain the different types of error detected by CRC code.	(8) (5)	**BTL 5**	**Evaluating**
10.	Draw the diagram of the ½ rate convolutional encoder with generator polynomials	(13)	**BTL 2**	**Understanding**

	$G^1(D)=1+D$ $G^2(D)=1+D+D^2$ And complete the encoder output for input sequence 101101.			
11.	(i)Draw the code tree of a Convolutional code of code rate r = 1/2 and constraintlength of K = 3 starting from state table and state diagram for an encoderwhich is commonly used. (ii) Draw and explain the trellis diagram representation of convolutional codes.	(9) (4)	**BTL 1**	**Remembering**
12.	(i) Demonstrate the generation of a code using a convolutional encoder with k=1, n=2 and r = ½. (ii) Calculate the encoded output for the input message 10011. (For a Convolutional encoder of constraint length 3 and rate ½.	(7) (6)	**BTL 3**	**Applying**
13.	(i) Identify a block code for a message block of size eight that can correct for single errors. (ii) Diagnose a convolutional coder of constraint length 6 and rate efficiency ½. Draw its tree diagram and trellis diagram.	(7) (6)	**BTL 4**	**Analyzing**
14.	(i) Devise the Maximum Likelihood decoding of Convolutional codes. (ii) Construct the state diagram for the convolutional encoder with k=1, n=2 and r=1/2., starting with the all zero state, trace the path that corresponds to the message sequence 10111…	(7) (6)	**BTL 6**	**Creating**

	PART - C			
1.	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. (iv) Decode the received words with an example.	(4) (4) (4) (3)	**BTL 5**	**Evaluating**
2	For a systematic (7,4) linear block code , whose generated matrix is given below $G = \begin{bmatrix} 1000:111 \\ 0100:110 \\ 0010:101 \\ 0001:011 \end{bmatrix}$ (i) Solve all the code vectors (ii) Find parity check matrix (H) (iii) Predict minimum weight	(5) (5) (5)	**BTL 6**	**Creating**
3	(i)Explain Viterbi algorithm with an appropriate coder and received input word of length 12. Assume a coder of constraint length 6 and rate efficiency ½. (ii)Assess a (7,4) binary cyclic code with a generator polynomial $g(x) = 1 + x + x^3$ draw the syndrome circuit.	(10) (5)	**BTL 5**	**Evaluating**
4	A convolutional code is described by g1=[1 0 0], g2=[1 0 1], g3=[1 1 1] (i) Build the encoder corresponding to the code. (ii) Develop the state transition diagram for this code. (iii) Draw the trellis diagram. (iv) Estimate the transfer function.	(4) (4) (4) (3)	**BTL 6**	**Creating**