INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**DIGITAL COMMUNICATIONS**				
Course Code	AEC009				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	3	2
Chief Coordinator	Dr. S.Vinoth, Associate Professor				
Course Faculty	Dr. V.Padmanabha Reddy, Professor Mr. G.Kiran Kumar, Assistant Professor				

COURSE OBJECTIVES:

I	Understand the different digital modulation techniques
II	Discuss the importance of error detection and correction codes and use them in presence of channel noise.
III	Describe and analyze the methods of transmission of digital data using baseband and carrier modulation techniques.
IV	Decompose codes separately into source codes, channel codes, and develop competency in modeling and analyzing communication system elements.

COURSE OUTCOMES (COs):

CO 1	Analyze, interpret and model the components of digital communication systems.
CO 2	Analyze, model, evaluate and compare various digital modulation techniques.
CO 3	Analyze, interpret and model baseband pulse transmission systems and digital pass band transmission systems.
CO 4	Analyze, evaluate information theory and compare spread spectrum techniques and performance of spread spectrum.
CO 5	Review, analyze and design error-correcting codes used in digital communication.

COURSE LEARNING OUTCOMES (CLOs):

AEC008.01	Understand the basic concepts of pulse amplitude modulation (PAM), pulse position modulation (PPM) and pulse width modulation (PWM).
AEC008.02	Describe the advantages and disadvantages of digital communication systems and remember the concept of pulse code modulation technique.
AEC008.03	Understand the concept of sampling, quantization and coding.
AEC008.04	Understand and remember the concept of amplitude shift keying modulation and demodulation.
AEC008.05	Analyze the frequency shift keying modulator, coherent and non-coherent frequency shift keying detectors.
AEC008.06	Describe the difference between binary phase shift keying ad quadrature phase shift keying techniques.
AEC008.07	Understand the concept of baseband transmission and various line-coding formats used in digital communication systems.
AEC008.08	Describe the significance of pulse shaping to reduce inter-symbol interference in digital communications.
AEC008.09	Understand the operation of raised cosine filter and eye patterns of various ASK PSK and FSK digital modulation techniques.
AEC008.10	Understand and Remember the concept of mutual information and entropy in information theory.
AEC008.11	Design various mathematical modeling schemes for communication channel and determine their channel capacity.
AEC008.12	Analyze various spread spectrum modulation schemes.
AEC008.13	Direct sequence spread spectrum and frequency hopping spread spectrum.
AEC008.14	Analyze the significance of linear block codes and convolution codes in digital communications. Interpret the difference between hamming codes and binary cyclic codes.
AEC008.15	Understand various types and approaches such as time domain approach and transform domain approach for implementation of convolution codes.
AEC008.16	Design different types of error detection and correction techniques for linear block codes and convolution codes.
AEC008.17	Acquire experience in building and troubleshooting simple digital communication system using digital modulation and demodulation techniques.
AEC008.18	Acquire the knowledge and develop capability to succeed in competitive examinations.

TUTORIAL QUESTION BANK

S.No	Question	Blooms taxonomy level	Course Outcomes	Course Learning Outcomes
UNIT-I PULSE DIGITAL MODULATION				
Part - A(Short Answer Questions)				
1	Discuss about the simplified Block diagram of an Electronic communication system	Remember	CO 1	AEC009.01
2	Describe the Pulse Modulation and types of pulse modulation techniques.	Remember	CO 1	AEC009.01
3	Discuss the advantages and disadvantages of digital communication system	Remember	CO 1	AEC009.03
4	Define Nyquist rate and sampling theorem.	Understand	CO 1	AEC009.03
5	Discuss about quantization and their types.	Remember	CO 1	AEC009.03
6	Discuss about uniform quantization?	Remember	CO 1	AEC009.03
7	Mention two major sources of noise which influence the performance of a PCM system.	Understand	CO 1	AEC009.02
8	List out the advantages of ADM over DM.	Understand	CO 1	AEC009.02
9	List out the advantages of DPCM over PCM.	Understand	CO 1	AEC009.02
10	Discuss the advantages of DM over PCM	Understand	CO 1	AEC009.02
11	Compare the features of PCM and DPCM	Understand	CO 1	AEC009.02
12	Discuss about Quantization error.	Understand	CO 1	AEC009.02
13	Discuss about companding in PCM.	Understand	CO 1	AEC009.02
14	List the applications of Digital communication systems.	Remember	CO 1	AEC009.02
15	Discuss the advantages and disadvantages of PCM	Remember	CO 1	AEC009.02
16	Discuss the advantages and disadvantages of PAM	Understand	CO 1	AEC009.01
17	Discuss the advantages and disadvantages of PWM	Understand	CO 1	AEC009.01
18	Discuss the advantages and disadvantages of PPM	Understand	CO 1	AEC009.01
19	List the applications of Pulse Code Modulation.	Understand	CO 1	AEC009.01
20	List the applications of Pulse Amplitude Modulation.	Understand	CO 1	AEC009.01
21	List the applications of Pulse Width Modulation.	Understand	CO 1	AEC009.01
Part - B (Long Answer Questions)				
1	Describe the Model of Digital Communication Systems with neat diagrams and list the advantages of digital communications over analog communications.	Remember	CO 1	AEC009.01
2	Discuss about Pulse Amplitude Modulation(PAM),Pulse Width Modulation (PWM) and Pulse Position Modulation(PPM) techniques with neat diagrams.	Understand	CO 1	AEC009.01
3	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?	Remember	CO 1	AEC009.01
4	Describe the process of Sampling and Quantization in digital Communication. What is aliasing effect in sampled signal? How aliasing can be eliminated? Explain with neat diagram.	Understand	CO 1	AEC009.03
5	Explain a)Channel Noise b) Quantization noise in Delata Modulation(DM) and derive expression for them?	Remember	CO 1	AEC009.03
6	Explain the generation of pulse code modulation(PCM) with a neat diagramand also discuss quantization noise and signal to noise ratio in PCM.	Understand	CO 1	AEC009.03
7	Describe Delta Modulation(DM) system. Also discuss the slope overload distortion and granular noise present in it.	Remember	CO 1	AEC009.03
8	Discuss the working of a quantizer and the need of the quantizer used in digital pulse modulaton techniques.	Remember	CO 1	AEC009.03
9	Discuss about Pulse code modulation and different types of noise effects in pulse code modulation.	Understand	CO 1	AEC009.02

S.No	Question	Blooms taxonomy level	Course Outcomes	Course Learning Outcomes
10	Explain the basic principle of DPCM and working of DPCM transmitter and receiver with the help of diagram. Derive an expression for channel noise in delta modulation.	Remember	CO 1	AEC009.02
11	What is aliasing effect in sampled signal? How aliasing effect can be eliminated? Explain with neat diagram.	Understand	CO 1	AEC009.01
12	Discuss the drawbacks of Delta modulation and how they overcome using adaptive delta modulation.	Remember	CO 1	AEC009.02
13	Explain a) Sampler b) Quantizer C.) Encoder in Pulse code Modulation Technique and derive expression for Quantization Noise and Quantization Error?	Remember	CO 1	AEC009.03
14	Explain Quantization? Explain the types of Quantization? What is Companding Technique and its Types?	Remember	CO 1	AEC009.03
15	Describe the Transmitter and Receiver part of the Differential Pulse Code Modulation Technique in detail? What are the difference between PCM and DPCM techniques?	Remember	CO 1	AEC009.03
16	Explain the generation and demodulation of the pulse amplitude modulation with block diagrams?	Remember	CO 1	AEC009.03
17	Give Brief description about the generation and demodulation of the pulse width modulation with block diagrams?	Remember	CO 1	AEC009.03
18	Explain the generation and demodulation of the pulse position modulation with block diagrams?	Understand	CO 1	AEC009.02
19	Describe Briefly about the Pulse analog Modulation Technique and its types?	Understand	CO 1	AEC009.02
20	What is Digital communication? Basic components of Digital communication? Advantages, Disadvantages and applications of Digital communication system?	Understand	CO 1	AEC009.02
Part - C (Analytical Questions)				
1	Specify the Nyquist rate and the Nyquist interval for each of the following signals: a)g(t)= sinc(200t) b) g(t)= sinc2(200t) c) g(t)= sinc(200t)+ sinc2(200t)	Understand	CO 1	AEC009.03
2	A message signal m(t) is transmitted by binary PCM without compression. Let the signalto-quantization noise (SNRq) required be at least 47 dB. Determine the minimum number of quantization levels L required, assuming that m(t) is sinusoidal. With this value of L, determine the SNR.	Remember	CO 1	AEC009.03
3	Find the maximum amplitude of a 1 KHz sinusoidal signal input to a delta modulator that will prevent slope overload, when the sampling rate is 10,000 samples/sec and the step size is $\Delta = 0.1$	Remember	CO 1	AEC009.02
4	Let $m(t) = Am \cos(2\pi fmt)$ be the input to a delta modulator with parameters Δ (step size) and Ts (sampling period). Show that the minimum sampling frequency fs,min, needed to avoid slope overload distorsion, is given by $fs,min = 2\pi fm Am /\Delta$	Understand	CO 1	AEC009.03
5	Find the maximum amplitude of a 1 KHz sinusoidal signal input to a delta modulator that will prevent slope overload, when the sampling rate is 10,000 samples/sec and the step size is $\Delta = 0.1$	Remember	CO 1	AEC009.03
6	Let $m(t) = Am \cos(2\pi fmt)$ be the input to a delta modulator with parameters Δ (step size) and Ts (sampling period). Show that the minimum sampling frequency fs,min, needed to avoid slope overload distorsion, is given by $fs,min = 2\pi fm Am/\Delta$.	Understand	CO 1	AEC009.03
7	The input to the PCM system is m(t)=10cos2πx104t, 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	Remember	CO 1	AEC009.03
8	For a DM system, signal sampled at 76 KHz and Amax = 4 (a) Assuming that the signal is sinusoidal determine output signal power & SNR. (b) Determine the minimum transmission Band width? Derive the relations	Understand	CO 1	AEC009.03

S.No	Question	Blooms taxonomy level	Course Outcomes	Course Learning Outcomes
9	Show that the use of A-law companding provides a ratio of maximum step size to minimum step size equal to the parameter A.	Remember	CO 1	AEC009.03
10	In a binary PCM system,the output to signal to quantization noise signal is to be held to be a minimum of 40db.Determine the number of required levels and find the corresponding output signal to quantization ratio.	Understand	CO 1	AEC009.03
	UNIT - II **DIGITAL MODULATION TECHNIQUES**			
	Part – A (Short Answer Questions)			
1	Construct the ASK waveforms for 011011.	Remember	CO 2	AEC009.04
2	Sketch the block diagram of ASK generation.	Remember	CO 2	AEC009.04
3	Construct the FSK waveforms for 011011.	Remember	CO 2	AEC009.05
4	Show the space representation of BPSK	Understand	CO 2	AEC009.06
5	Explain the Bandwidth, power and energy calculations for PSK signal.	Remember	CO 2	AEC009.06
6	Explain why PSK is always preferable over ASK in coherent detection?	Understand	CO 2	AEC009.04
7	Distinguish between Coherent and Non coherent detection?	Remember	CO 2	AEC009.05
8	Explain Phase shift keying with relevant equations and waveforms.	Understand	CO 2	AEC009.06
9	Estimate the band width required for frequency shift keying	Remember	CO 2	AEC009.05
10	Explain non coherent detection of Amplitude shift keying.	Understand	CO 2	AEC009.04
11	Construct the constellation diagram for Quadrature phase shift keying.	Remember	CO 2	AEC009.06
12	Explain coherent detection of frequency shift keying .	Understand	CO 2	AEC009.05
13	Construct the FSK waveforms for a given input data “1101”.	Remember	CO 2	AEC009.05
14	Define the probability of error	Understand	CO 2	AEC009.05
15	Draw FSK spectrum	Remember	CO 2	AEC009.05
16	What should be the relationship between bit rate and frequency shift for a better performance?	Understand	CO 2	AEC009.05
17	Show the space representation of QPSK	Remember	CO 2	AEC009.06
18	What is the probability of error for ASK, FSK, BPSK.	Understand	CO 2	AEC009.05
19	What is the probability of error using matched filter.	Remember	CO 2	AEC009.06
20	What is a optimum and matched filter?	Understand	CO 2	AEC009.05
21	Explain the advantages of Coherent modulation schemes.	Remember	CO 2	AEC009.05
	Part - B (Long Answer Questions)			
1	Explain in detail about modulation and demodulation of i)Frequency Shift Keying(FSK) ii)Phase Shift Keying(PSK) with waveforms and equations.	Remember	CO 2	AEC009.06
2	Explain Differential Phase Shift Keying modulation(DPSK) and Demodulation with neat block diagrams and also sketches the binary PSK for the bit sequence 0110101001.	Understand	CO 2	AEC009.06
3	Draw the block diagram of QPSK demodulator and explain in detail.	Remember	CO 2	AEC009.06
4	Draw the structure of the receiver for an orthogonal wideband FSK signaling scheme and derive a relation for probability of error.	Understand	CO 2	AEC009.05
5	Compare digital modulation systems Amplitude shift keying(ASK),Frequency shift keying(FSK) and Phase shift keying(PSK)..	Remember	CO 2	AEC009.04
6	Derive an expression for probability of error in Frequency shift keying system.	Understand	CO 2	AEC009.05

S.No	Question	Blooms taxonomy level	Course Outcomes	Course Learning Outcomes
7	(a) Derive an expression for probability of bit error of a binary coherent FSK receiver. (b) Derive an expression for probability of bit error of a binary non-coherent ASK.	Remember	CO 2	AEC009.05
8	Discuss about Quadrature Phase Shift Keying in detail with an example and draw the waveforms and sketch the QPSK waveform for the sequence 1101010010.	Understand	CO 2	AEC009.06
9	Explain Differential phase shift keying modulation and demodulation with neat block diagram. Draw the wave forms for the bit stream 1011100011 using DPSK.	Remember	CO 2	AEC009.06
10	Draw the block diagram of Amplitude shift keying modulator and demodulator and explain in detail and sketch the ASK waveform for the sequence 1101010010. .	Understand	CO 2	AEC009.04
11	With neat diagrams explain the generation of Differentially encoded phase shift keying and sketch the Frequency shift keying waveform for the sequence 1101010010.	Remember	CO 2	AEC009.06
12	Explain briefly about the Amplitude shift keying Modulator? Also Discuss briefly about the coherent and non coherent ASK detector?	Understand	CO 2	AEC009.04
13	What is base band signal receiver? Probability of error? What are the types of filters?	Remember	CO 2	AEC009.05
14	Explain in detail about the Modulation and Detection part of the Differential phase shift keying Technique (DPSK)? Explain briefly about DEPSK?	Understand	CO 2	AEC009.06
15	Discuss about the BPSK modulator and the coherent detection of the BPSK detector?	Understand	CO 2	AEC009.05
16	What is optimum filter and matched filter? What is the probability of error of optimum filter and matched filter?	Remember	CO 2	AEC009.05
17	What is Line encoding Formats? Explain various line encoding formats and its probability of error?	Remember	CO 2	AEC009.05
18	Describe the bandwidth & frequency spectrum of FSK and its detectors?	Understand	CO 2	AEC009.05
19	What is Phase shift keying? Explain briefly about BPSK, QPSK, DPSK, DEPSK?	Understand	CO 2	AEC009.06
20	What is Optimum reception of the digital signal? What is Baseband signal receiver? What is correlation receiver?	Remember	CO 2	AEC009.06
Part - C (Analytical Questions)				
1	A bandpass QPSK modulation system uses the following orthonormal signals, $\psi 1(t) = 110 \cos(104\pi t)$, $\psi 2(t) = 110 \sin(104\pi t)$. Noise is AWGN with N0 = 1 and the target probability of a bit error is Pb = $10^{-5.}$ A) Determine the maximum bit rate (bps) of this system. B) Sketch the constellation points used in the bits-to-signal mapper.	Remember	CO 2	AEC009.06
2	The bit stream 11011100101 is to be transmitted using DPSK. Determine the encoded sequence and the transmitted phase sequence	Understand	CO 2	AEC009.06
3	For the signals, the given bit rate is 10Kbps. Estimate the bandwidth for AmplitudeShist Keying and Frequency Shift Keying signals.	Remember	CO 2	AEC009.05
4	Assume that 3600 bits/sec data is sent over a pass band channel by Frequency Shift Keying signaling scheme. Estimate the transmission bandwidth.	Understand	CO 2	AEC009.05
5	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 f1=8MHz and f2=6MHz	Remember	CO 2	AEC009.06

6	You have an FSK transmitter using a carrier of 500 kHz sending 10 kbps and a frequency deviation of 100 kHz. How much bandwidth do you need for your transmission?	Understand	CO 2	AEC009.04
7	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.	Remember	CO 2	AEC009.05
8	Binary PSK (BPSK) is used for data transmission over an AWGN channel with power spectral density N0/2 = 10−10 W/Hz. The transmitted signal energy is Eb = A2T /2, where T is the bit duration and A is the signal amplitude. Determine the value of A needed to achieve an error probability of 10−6, if the data rate is: (a) 10 Kbit/s (b) 100 Kbit/s (c) 1 Mbit/s	Understand	CO 2	AEC009.06
9	Find z = Eb/N0 required to give Pb = 10−5 for the following coherent digital modulation schemes: (a) on-off keying (ASK), (b) BPSK, (c) BFSK and (d) BPSK with a phase error of 5 deg.	Remember	CO 2	AEC009.06
10	The bit stream 11010101011 is to be transmitted using Differential Phase Shift Keying. Determine the encoded sequence and the transmitted phase sequence	Understand	CO 2	AEC009.06
UNIT-III **BASE BAND TRANSMISSION AND PULSE SHAPING**				
Part - A (Short Answer Questions)				
1	What are the requirements of line encoding format.	Remember	CO 3	AEC009.07
2	List the various types of line encoding formats.	Understand	CO 3	AEC009.07
3	What is Unipolar line encoding format.	Remember	CO 3	AEC009.07
4	What is Polar line encoding format.	Understand	CO 3	AEC009.07
5	What is Bipolar line encoding format.	Remember	CO 3	AEC009.07
6	Write the advantages and disadvantages of Unipolar line encoding format.	Understand	CO 3	AEC009.07
7	Write the advantages and disadvantages of Polar line encoding format.	Remember	CO 3	AEC009.07
8	Write the advantages and disadvantages of Bipolar line encoding format.	Understand	CO 3	AEC009.07
9	What is BZ8S Scrambling technique?	Remember	CO 3	AEC009.07
10	What is HDB3 Scrambling technique?	Understand	CO 3	AEC009.07
11	Draw the NRZ and RZ code for the digital data 10110001	Remember	CO 3	AEC009.07
12	Draw the RZ- bipolar line code for the information {10110}	Understand	CO 3	AEC009.07
CIE-II				
1	List out the use of eye patterns	Remember	CO 3	AEC009.09
2	State any 2 applications of eye pattern	Understand	CO 3	AEC009.09
3	State Nyquist criterion for zero ISI.	Remember	CO 3	AEC009.08
4	How does pulse shaping reduce inter symbol interference?	Understand	CO 3	AEC009.08
5	How do we get eye pattern? What you infer from this?	Remember	CO 3	AEC009.09
6	ISI cannot be avoided. Justify the statement?	Understand	CO 3	AEC009.09
7	What is correlative coding?	Remember	CO 3	AEC009.08
8	What is Inter symbol interference?	Understand	CO 3	AEC009.07
9	What is Raised cosine filter?	Remember	CO 3	AEC009.08
10	What is equalization?	Understand	CO 3	AEC009.08
Part - B (Long Answer Questions)				
1	Explain in detail about Unipolar line encoding format and represent the data 100111010 using the unipolar RZ and unipolar NRZ digital data format.	Remember	CO 3	AEC009.07
2	Describe about detail about Polar line encoding format and represent the data 100111010 using the polar RZ and polar NRZ digital data format.	Understand	CO 3	AEC009.07
3	Discuss in detail about Bipolar line encoding format and represent the data 100111010 using the bipolar NRZ digital data format.	Remember	CO 3	AEC009.07

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4	The bit stream {bn} = 0, 1, 1, 0, 0, 0, 1, 0 is to be sent through a channel. Assume that rectangular pulses of amplitude A are used and the bit rate is 1/T bps. Sketch the transmitted signal for each of the following line coding schemes: (a)Unipolar NRZ (b) Unipolar RZ (c) Polar NRZ (d) Polar RZ	Understand	CO 3	AEC009.07
5	Discuss in detail about HDB3 Scrambling technique represent the data 0100111100100001100 using using the HDB3 Scrambling technique.	Remember	CO 3	AEC009.07
6	Draw Power Spectral Density for various line encoding formats and represent the Bipolar NRZ, split phase Manchester, polar RZ and AMI for the bit stream 11001001.	Understand	CO 3	AEC009.07
7	Give a brief description about Scrambling techniques? i.) BZ8S, ii.) HDB3	Understand	CO 3	AEC009.07
8	What is line encoding Formats? What are the requirements of Line encoding formats? Explain briefly about the various line encoding formats.	Remember	CO 3	AEC009.07
	CIE-II			
1	Describe how the inter symbol interference(ISI) in data transmission can be studied with the help of a display in the oscilloscope called eye diagram.	Understand	CO 3	AEC009.09
2	What is meant by Cross talk? Explain in detail about the causes for cross talk in base band transmission.	Remember	CO 3	AEC009.09
3	What is the need of pulse shaping for optimum transmission in baseband transmission? Explain.	Understand	CO 3	AEC009.08
4	Discuss the information about performance of a system provided by the eye pattern. Draw the eye diagram for Amplitude Shift Keying, frequency shift keying and phase shift keying.	Remember	CO 3	AEC009.09
5	Define eye diagram. Draw the eye diagram for PSK.	Understand	CO 3	AEC009.09
6	Draw and explain the block diagram of modified duo-binary signaling scheme Consider the binary sequence bk=”01001101” applied to the input of a precoded modified duobinary sequence.Determine the sequence ak at the precoder output.	Remember	CO 3	AEC009.07
7	Explain how Inter Symbol Interference(ISI) occurs in base-band binary data transmission system and describe the pulse shaping method to minimize ISI.	Understand	CO 3	AEC009.07
8	Describe the Nyquist bandwidth requirement of raised cosine filter for distortion less transmission and define roll off factor .	Remember	CO 3	AEC009.07
9	Draw and explain the block diagram of duo-binary signaling scheme for controlled ISI. Show that the binary sequence “01011010” can be detected in the absence of noise irrespective of the choice of the extra bit.	Remember	CO 3	AEC009.08
10	Briefly describe about Duo-binary encoding Technique and modified duo-binary encoding technique?	Remember	CO 3	AEC009.08
11	Describe briefly about the eye diagram. Draw the eye diagram for ASK and FSK?	Understand	CO 3	AEC009.09
12	Briefly explain the raised cosine filter and Equalization?	Understand	CO 3	AEC009.08
	Part - C (Analytical Questions)			
1	A line coding scheme uses Unipolar NRZ and RZ encoding with rectangular pulses. Sketch the signal corresponding to the bit sequence “110101”.	Remember	CO 3	AEC009.07
2	A line coding scheme uses Polar NRZ and RZ encoding with rectangular pulses. Sketch the signal corresponding to the bit sequence “100101”.	Understand	CO 3	AEC009.07
3	A line coding scheme uses Bipolar NRZ and RZ encoding with rectangular pulses. Sketch the signal corresponding to the bit sequence “101110”.	Remember	CO 3	AEC009.07

4	A scrambling coding scheme uses BZ8S with rectangular pulses. Sketch the signal corresponding to the bit sequence "0110000000100001100".	Understand	CO 3	AEC009.07
5	A scrambling coding scheme uses HDB3 with rectangular pulses. Sketch the signal corresponding to the bit sequence "0110000000100001100".	Remember	CO 3	AEC009.07
	CIE-II			
1	The Fourier transform P(f) of the basis pulse p(t) employed in a certain binary communication system is given by P(f) = {10−6 (1 – (|f|/ 106)) ; if 10−6 ≤ f(hz) ≤ 106 ; =0 other wise. (a) From the shape of P(f), explain whether this pulse satisfies the Nyquist criterion for ISI free transmission. (b) Determine p(t) and verify your result in part a. (c) If the pulse does satisfy the Nyquist criterion. What is the transmission rate (in bits/sec.) and what is the roll-off factor?	Remember	CO 3	AEC009.08
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 α=0.2 are used the sampling rate must be at least 25% above the Nyquist rate.	Understand	CO 3	AEC009.08
3	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 α=0.25.	Remember	CO 3	AEC009.08
4	A telephone line of bandwidth 4Khz required to transmit data at 6kbps using raised cosine pulses. Determine the roll of factor α	Understand	CO 3	AEC009.08
5	A communication channel of bandwidth 75 KHz is required to transmit binary data at a rate of 0.1Mb/s using raised cosine pulses. Determine the roll off factor α.	Remember	CO 3	AEC009.08
	UNIT-IV **INFORMATION THEORY AND SOURCE CODING**			
	Part - A (Short Answer Questions)			
1	Define conditional entropy.	Understand	CO 4	AEC009.10
2	List out the applications of CDMA.	Remember	CO 4	AEC009.10
3	Define spread spectrum. List its uses.	Understand	CO 4	AEC009.12
4	What is Hartley Shannon law?	Remember	CO 4	AEC009.12
5	Define Entropy.	Understand	CO 4	AEC009.10
6	Derive the Expression for the Information Rate.	Remember	CO 4	AEC009.11
7	Briefly explain about "Spread spectrum."	Understand	CO 4	AEC009.12
8	What is Frequency hopping spread spectrum?	Remember	CO 4	AEC009.12
9	State four applications of spread spectrum.	Understand	CO 4	AEC009.12
10	Discuss the applications of spread spectrum modulation?	Remember	CO 4	AEC009.12
11	Show that information contained by a symbol is inversely proportional to the probability of that symbol.	Understand	CO 4	AEC009.11
12	Show that the entropy is maximum when all the symbols are equi probable. Assume M=2.	Remember	CO 4	AEC009.10
13	Discuss Various mathematical modeling of communication channels and their capacities.	Understand	CO 4	AEC009.11

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14	Write any two differences between Fixed length and variable length Source Coding Schemes.	Remember	CO 4	AEC009.10
15	Discuss how Source coding is used to increase average information per bit.	Understand	CO 4	AEC009.10
16	What is frequency hopping? Define Frequency-hopping spread spectrum (FHSS)?	Remember	CO 4	AEC009.10
18	State the Shannon-fano algorithm?	Understand	CO 4	AEC009.11
19	What is mean by Pseudo-Noise Sequence?	Remember	CO 4	AEC009.10
20	Define Huffman coding.	Understand	CO 4	AEC009.11
	Part – B (Long Answer Questions)			
1	A source emits on dependent sequences of symbols from a source alphabet containing five symbols with probabilities 0.4, 0.2, 0.2, 0.1 and 0.1 compute the entropy of the source..	Remember	CO 4	AEC009.10
2	Show that H(X, Y) = H(X) + H(YIX) = H(Y) + H(XI Y).	Understand	CO 4	AEC009.11
3	Define spread spectrum system, applications of spread spectrum and what are the various types of the system.	Understand	CO 4	AEC009.12
4	How spread spectrum methods are classified and what is the basis of classification.	Remember	CO 4	AEC009.10
5	What are pseudo-noise sequences and why they are used in spread spectrum modulation..	Understand	CO 4	AEC009.11
6	Describe the role of code division multiple access technique in present generation?	Remember	CO 4	AEC009.12
7	Give a brief history about direct sequence spread spectrum.	Understand	CO 4	AEC009.12
8	A source emits four symbols with probabilities P0, P1, P2, and P3. Find out the amount of information obtained due to these four symbols..	Remember		AEC009.11
9	What is meant by Synchronization? Why we require synchronization in spread spectrum? Explain in detail.	Remember	CO 4	AEC009.11
10	A source transmits two independent messages with probabilities of P and (1-P) respectivily. Prove that the entropy is maximum when both the messages are equally likely.	Understand	CO 4	AEC009.12
11	Prove that mutual information of the channel is symmetric i.e, I(X;Y) = I(Y;X).	Understand	CO 4	AEC009.11
12	Show that if there are „M" number of equally likely messages, then entropy of the source is log2M.	Remember	CO 4	AEC009.12
13	Define the following, i)Information ii) Entropy iii) Rate of Information iv) Channel Capacity	Understand	CO 4	AEC009.11
14	Prove that mutual information of the channel is symmetric i.e, I(X;Y) = I(Y;X).	Understand	CO 4	AEC009.11
15	Describe briefly about Direct sequence spread spectrum.	Understand	CO 4	AEC009.12
16	Give brief explanation about Source coding. i.) Huffman coding ii.) Lossy source coding.	Remember	CO 4	AEC009.12
17	Describe Synchronization? Why synchronization in spread spectrum is essential? Explain in detail.	Remember	CO 4	AEC009.11
18	Explain code division multiple access technique using DSSS.	Remember	CO 4	AEC009.12
19	Explain in detail about the Frequency hopping spread spectrum.	Remember	CO 4	AEC009.11
20	Describe briefly about the fixed length and variable length Source Coding Schemes?	Remember	CO 4	AEC009.12
	Part - C (Analytical Questions)			
1	A source is transmitting Four symbols A, B, C and D with probabilities 1/2, 1/4, 1/8 and 1/8 respectively. Find the entropy	Understand	CO 4	AEC009.01

	of the source and find information rate if r=1 messages/sec.			
2	In a message conveyed through a long sequence of dots and dashes, the probability of occurrence of a dash is two third of that of dot. The duration of a dash is four times that of a dot. If a dot losts for 10msec and the same time is allowed between symbols, determine i)The information in dot and dash ii)Average information in dot-dash code iii)Average information rate	Remember	CO 4	AEC009.10
3	A source is transmitting the symbols A and B with probabilities 1/16 and 15/16 respectively. Calculate the Entropy of the source and the required channel capacity using the simplest code and also coding efficiency.	Remember	CO 4	AEC009.10
4	One of five possible message Q1 to Q5 having probabilities 1/4, 1/2, 1/8, 1/16, 1/16 respectively are transmitted. Generate Huffman code and Calculate the coding efficiency	Remember	CO 4	AEC009.11
5	If I(x1) id the information carried by symbol x1 and I(x2) id the information carried by symbol x2 then prove that the amount of information carried compositely due to x1and x2 is I(x1, x2)= I(x1) I(x2)	Understand	CO 4	AEC009.11
6	Apply Shannon fano coding for the 5 messages with probabilities 0.4, 0.15, 0.15, 0.15, 0.15 and find the coding efficiency	Remember	CO 4	AEC009.10
7	Consider a discrete memory less source with source alphabet S={s0, s1, s2} and source statistics {0.7,0.15,0.15}.Calculate the Entropy of source.	Remember	CO 4	AEC009.11
8	An event has six possible outcomes with the probabilities P1= ½, P2= ¼, P3= 1/8, P4=1/16, P5= 1/32, p6=1/32. What is the entropy of the system?	Understand	CO 4	AEC009.10
9	A source is transmitting the symbols A and B with probabilities 1/16 and 15/16 respectively. Calculate the Entropy of the source And the required channel capacity using the simplest code and also coding efficiency.	Remember	CO 4	AEC009.10
10	One of five possible message Q1 to Q5 having probabilities 1/4, 1/2, 1/8, 1/16, 1/16 respectively are transmitted. Generate Huffman code and Calculate the coding efficiency	Remember	CO 4	AEC009.11
UNIT-V LINEAR BLOCK CODES AND CONVOLUTIONAL CODES				
Part - A (Short Answer Questions)				
1	Mention the properties of cyclic code.	Remember	CO 5	AEC009.14
2	Write the advantages of convolution codes.	Understand	CO 5	AEC009.15
3	Explain in one sentence about (i) Block Size (ii) Linear block codes.	Remember	CO 5	AEC009.13
4	List out Properties of Cyclic Codes.	Understand	CO 5	AEC009.14
5	List the advantages and disadvantages of convolution codes.	Remember	CO 5	AEC009.14
6	What are cyclic codes? List the advantages and disadvantages of it.	Understand	CO 5	AEC009.14
7	Discuss the difference between convolution code and block code.	Remember	CO 5	AEC009.14
8	Explain how syndrome is calculated in Hamming codes and cyclic codes?	Understand	CO 5	AEC009.15
9	Define code word & block length.	Remember	CO 5	AEC009.13
10	What is the code length of a convolution code?	Understand	CO 5	AEC009.15
11	What are the conditions to satisfy the hamming code?	Remember	CO 5	AEC009.14
12	Explain about the Convolution interleaving.	Remember	CO 5	AEC009.15
13	What is Viterbi algorithm?	Understand	CO 5	AEC009.14
14	What is interleaving?	Remember	CO 5	AEC009.14
15	What is Turbo Codes?	Understand	CO 5	AEC009.13
16	What is Low density parity check code (LDPC)?	Understand	CO 5	AEC009.15
17	What is Random & Burst Errors?.	Remember	CO 5	AEC009.13

18	What is Block interleaving?	Remember	CO 5	AEC009.15
19	What is Even & Odd parity check code?	Understand	CO 5	AEC009.13
20	What is Code rate ?	Understand	CO 5	AEC009.13
Part - B (Long Answer Questions)				
1	For a linear block code, prove that the syndrome depends only on Error pattern and not on transmitted codeword.	Remember	CO 5	AEC009.14
	For a linear block code, prove that all the error patterns that Differ by a codeword have the same syndrome.	Understand		AEC009.14
2	Consider an (n,k) linear block code with generator matrix G and parity check matrix H. the (n, n-k) code generated by H is called the dual code of (n, k) code.	Remember	CO 5	AEC009.13
3	Show that the syndrome „S" corresponds to rows of HT representing error location in error pattern.	Remember	CO 5	AEC009.14
4	Explain about Error detection and Correction capabilities of Hamming codes.	Understand	CO 5	AEC009.14
5	Explain how Parity checking can be used for error detection or Error correction.	Remember	CO 5	AEC009.14
6	For a linear block code, prove with example that: i) The Syndrome depends only on error pattern and not on transmitted code word? ii) All error patterns that differ by a codeword have the same syndrome?	Understand	CO 5	AEC009.13
7	What is the structural representation of Linear Block codes and give the Matrix description of Linear Block codes.	Remember	CO 5	AEC009.13
8	Write short notes on following with examples: Convolutional codes Viterbi Decoding.	Remember	CO 5	AEC009.15
9	With an example explain the error correction capability using Hamming codes	Understand	CO 5	AEC009.14
10	a) What is the significance of Trellis structure? Explain b) With neat sketch explain the procedure for Syndrome calculation.	Remember	CO 5	AEC009.15
11	What is the use of syndrome? Draw the (n-k) syndrome calculation circuit for (n,k) cyclic code? Explain	Understand	CO 5	AEC009.13
12	A generator polynomial of a (7, 4) cyclic code is G(p) = p3 + p + 1. Find the code vectors for the code in nonsystematic form.	Remember	CO 5	AEC009.13
13	Find the possible generator polynomials (7, 4) cyclic code. Find out the code vector corresponding to these generator polynomials.	Understand	CO 5	AEC009.15
14	Design syndrome calculator for a (7, 4) cyclic hamming code generator by the polynomial G(p) = p3 + p + 1.	Remember	CO 5	AEC009.15
15	Consider the (15, 9) cyclic code generated by G(p) = p6 + p5 + p4+ p3 + 1. This code has a burst error correcting ability of q = 3. Find burst error correcting efficiency of this code.	Understand	CO 5	AEC009.13
16	Construct a systematic (7, 4) cyclic code using the generator polynomial g(x) = x3+ x+1. What are the error correcting capabilities of this code?	Remember	CO 5	AEC009.15
17	Describe about the Error detecting and correction of hamming codes.	Remember	CO 5	AEC009.15
18	Give a brief description of transform domain, Time domain and frequency domain approach.	Remember	CO 5	AEC009.15
19	Briefly explain about the Interleaving technique. i.)Block Interleaving ii.) Convolution Interleaving	Understand	CO 5	AEC009.15
20	Explain briefly about the decoding process using viterbi algorithm.	Remember	CO 5	AEC009.14
Part - C (Analytical Questions)				
1	Decode the given sequence 11 01 01 10 01 of a convolutional code with a code rate of r=1/2 and constraint length K=3, using viterbi decoding algorithm.	Remember	CO 5	AEC009.15
2	Consider (7, 4) linear code whose generator matrix is- G = 1 0 0 0 : 1 0 1 0 1 0 0 : 1 1 1 0 0 1 0 : 1 1 0	Understand	CO 5	AEC009.13

	0 0 0 1 : 0 1 1 (i) Find all code vectors of this code. (ii)Find the parity check matrix for this code. (iii) Find the minimum weight of this code. (iv) Prove equation $CH^T=0$			
3	Draw the trellis diagram of a Convolutional code of code rate r=1/2 and Constraint length of K=3 starting from the state table and state diagram for an encoder which is commonly used.	Remember	CO 5	AEC009.13
4	For a (6, 3) systematic linear block code, the three parity check bits c4, c5, c6 are formed from the following equations. C4=d1+d3 C5=d1+d2+d3 C6=d1+d2 a) Construct the generator matrix G. b) Construct all possible code words	Remember	CO 5	AEC009.14
5	Consider the (8,4) linear block code with G= 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 (a) Construct all the possible code words (b) Construct all the single error patterns	Understand	CO 5	AEC009.14
6	For a cyclic code the generator polynomial g(x) = (x3+x2+1). a) If the received code is 1000110, determine the transmitted data. b) If the received code is 1101101, determine the transmitted data.	Remember	CO 5	AEC009.15
7	Consider a (7,4) cyclic code with generator polynomial g(x)= (x3+x2+1).Determine the code for data bits 1010,1111, and 0001	Remember	CO 5	AEC009.15
8	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.	Understand	CO 5	AEC009.14
9	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	CO 5	AEC009.15
10	Find the code word for data word 1110 in a (7,4) cyclic code using the generator polynomial g(x)=1+x2+x3 using encoder	Remember	CO 5	AEC009.13

Prepared By:

Dr. S Vinoth, Associate Professor

HOD, ECE