SARDAR RAJA COLLEGE OF ENGINEERING, ALANGULAM

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MICRO LESSON PLAN

SUBJECT NAME : DIGITAL COMMUNICATION

SUBJECT CODE : EC 2301

CLASS : III YEAR B.E/V SEM

STAFF NAME

Ms. M.EBENEZER PRATHIBA

ECE

EC2301 DIGITAL COMMUNICATION L T P C 3 0 0 3

UNIT I DIGITAL COMMUNICATION SYSTEM 8

Introduction to Analog Pulse Communication Systems – Digital Communication System – Functional description, Channel classification, Performance Measure; Geometric representation of Signals, Bandwidth , Mathematical Models of Communication Channel.

UNIT II BASEBAND FORMATTING TECHNIQUES 10

Sampling – Impulse sampling, Natural Sampling, Sampler Implementation; Quantisation – Uniform and Non-uniform; Encoding Techniques for Analog Sources- Temporal waveform encoding, Spectral waveform encoding, Model-based encoding, Comparison of speech encoding methods.

UNIT III BASEBAND CODING TECHNIQUES 9

Error Control Codes - Block Codes , Convolutional Codes, Concept of Error Free Communication; Classification of line codes, desirable characteristics and power spectra of line codes.

UNIT IV BASEBAND RECEPTION TECHNIQUES 9

Noise in Communication Systems; Receiving Filter – Correlator type, Matched Filter type; Equalising Filter - Signal and system design for ISI elimination, Implementation, Eye Pattern analysis; Synchronisation; Detector – Maximum Likelihood Detector, Error Probability, Figure-of-Merit for Digital Detection.

UNIT V BANDPASS SIGNAL TRANSMISSION AND RECEPTION 9

Memory less modulation methods - Representation and Spectral characteristics, ASK, PSK, QAM, QPSK, FSK; Bandpass receiving filter, Error performance – Coherent and Non-coherent detection systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Amitabha Bhattacharya, "Digital Communications", Tata McGraw Hill, 2006.

2. Simon Haykin, "Digital Communications", John Wiley, 2006.

REFERENCES:

1. John.G. Proakis, " Fundamentals of Communication Systems", Pearson Education, 2006.

2. Michael. B. Purrsley, "Introduction to Digital Communication", Pearson Education, 2006.

3. Bernard Sklar, Digital Communication, 2nd Edition, Paerson Education, 2006

4. Herbert Taub & Donald L Schilling – Principles of Communication Systems (3^{rd} Edition) – Tata McGraw Hill, 2008.

5. Leon W. Couch, Digital and Analog Communication Systems, 6th Edition, Pearson Education, 2001.

AIM:

To introduce the basic concepts of Digital Communication in baseband and passband domains and to give an exposure to error control coding techniques.

OBJECTIVES:

- To study the digital communication fundamentals and mathematical models of Communication Channel.
- To study the base band formatting techniques
- To study signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To understand baseband and bandpass signal transmission and reception techniques.
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

DESCRIPTION:

This subject presents and discusses several topics in base band and pass baseband digital communication (Digital communication systems, base band formatting techniques, Base band coding techniques, base band reception techniques, band pass signal transmission and reception), with application in optical, satellite and multimedia applications

Data transmission, digital transmission, or digital communications is the physical transfer of data (a digital bit stream) over a point-to-point or point-to-multipoint communication channel. Examples of such channels are copper wires, optical fibers, wireless communication channels, and storage media. The data are represented as an electromagnetic signal, such as an electrical voltage, radio wave, microwave, or infrared signal.

While analog transmission is the transfer of a continuously varying analog signal, digital communications is the transfer of discrete messages. The messages are either represented by a sequence of pulses by means of a line code (baseband transmission), or by a limited set of continuously varying wave forms (passband transmission), using a digital modulation method. The passband modulation and corresponding demodulation (also known as detection) is carried out by modem equipment. According to the most common definition of digital signal, both baseband

and passband signals representing bit-streams are considered as digital transmission, while an alternative definition only considers the baseband signal as digital, and passband transmission of digital data as a form of digital-to-analog conversion.

Data transmitted may be digital messages originating from a data source, for example a computer or a keyboard. It may also be an analog signal such as a phone call or a video signal, digitized into a bit-stream for example using pulse-code modulation (PCM) or more advanced source coding (analog-to-digital conversion and data compression) schemes. This source coding and decoding is carried out by codec equipment.

MICRO LESSON PLAN

WEEK	HOURS	LECTURE TOPICS	BOOK
UNIT I DIGITAL COMMUNICATION SYSTEM			
I	1,2	Introduction to Analog Pulse Communication Systems	R4&R5
	3	Digital Communication Systems – Fundamental description (AV)	T1
	4	Channel Classification	
	5	Performance Measure	
II	6,7	Geometric Representation of Signal	
	8	Mathematical Models for communication Channel	
	9	Bandwidth	
UNIT II BASEBAND FORMATING TECHNIQUES			
III	10	Sampling- Impulse Sampling	T1
	11	Natural Sampling	
	12	Sampler Implementation	
	13,14	Quantization – Uniform and Non-uniform (AV)	
IV	15,16	Encoding Techniques for Analog Sources – Temporal Waveform Encoding (AV)	T1&T2
	17	Spectral Waveform Encoding	T1
	18	Model Based Encoding,	
	19	Comparison of speech encoding methods	

UNIT III BASEBAND CODING TECHNIUQUES			
V	20	Error Control Codes (AV)	T1
	21,22	Block Codes	T1&T2
	23,24	Convolutional Codes (AV)	T1&T2
VI	25	Concept of Error Free Communication	T1
	26	Classification of Line Codes	
	27	Desirable Characteristics Line Codes	
	28	Power Spectra of Line Codes	
UNIT IV BASEBAND RECEPTION TECHNIQUES			
VII	29	Noise in Communication systems (AV)	T1
	30,31	Receiving Filter – Correlator Type	
	32	Matched Filter type (AV)	T1&T2
	33	Equalizing filter, Implementation	T1
VIII	34	Signal and System design for ISI Elimination	
	35	Eye Pattern Analysis	
	36	Synchronization	
	37	Detector – Maximum likelihood detector	
	38	Error Probability, Figure -of-Merit for Digital Detection.	

UNIT V BANDPASS SIGNAL TRANSMISSION AND RECEPTION			
IX	39	Memory Less Modulation Methods - Representation & Spectral characteristics	T1
	40	ASK (Amplitude Shift Keying)	
	41	PSK (Phase Shift Keying)	
	42	QAM (Quadrature Amplitude Modulation) (AV)	
	43	QPSK (Quadrature Phase Shift Keying)	
X	44	FSK (Frequency Shift Keying) (AV)	
	45	Band pass Receiving filter	
	46	Error Performance – Coherent Systems	
	47	Non-Coherent Detection Systems	

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER / DECEMBER 2010

Fifth Semester

Electronics and Communication Engineering

EC 2301 DIGITAL COMMUNICATION

(Regulations 2008)

Time: Three Hours Maximum: 100 marks Answer ALL Questions

PART A (10 * 2 = 20 marks)

1. Which parameter is called figure of merit of digital communication system and why?
2. What is mean by distortion less transmission?
3. Why is prefiguring done before sampling?
4. Define quantization noise power.
5. Define Hamming distance and calculate its value for two code words 11100 and 11011.
6. Draw the NRZ and RZ code for the digital data 10110001.
7. What is the need for demodulator in the case of baseband digital signaling when the received signal waveforms are already in form of pulse like form?
8. How does pulse shaping reduce intersymbol interference?
9. Define QAM and draw its constellation diagram.
10. A binary frequency shift keying system employs two signaling frequencies $_1$f and $_2$f. The lower frequency $_1$f is 1200 Hz and signaling rate is 500 Baud. Calculate $_2$f.

PART B (5*16 = 80)

11) (a) Draw a neat block diagram of typical digital communication system and explain the function key of the signal processing blocks. (16)

Or

11) (b) (i) Distinguish between baseband and Bandpass signaling (6) (ii) Explain binary symmetric channel and Gaussian channel with their mathematical models.

(10)

12) (a) state the Nyquist sampling theorem. Demonstrate its validity for an analog signal x(t) having a Fourier transform x(f) which is zero outside the interval [] mm $-f < f < +f$. (16)

Or

12) (b) Explain in detail the various source coding techniques for speech signal and compare their performance. (16)

13) (a) For (6,3) systematic linear block codes the codeword comprises $_1I$, $_2I$, $_3I$, $_1P$, $_2P$, $_3P$ where the three parity check bits $_1P$, $_2P$, $_3P$ are formatted from the information bits as follows: (16) $P_1 = I_1? I_2$

$P_2 = I_1? I_3$

$P_3 = I_2?$

I_3 Find

(i) The parity check matrix

(ii) The generator matrix

(iii)All possible codewords.

(iv) Minimum weighted and minimum distance and

(v) The error detecting and correcting of the code.

(vi) If the received sequence is 10,000

Calculate the syndrome and decode the received sequence.

Or

13) (b) (i) Explain how encoding is done by convolutional codes with suitable example. (10)

(ii) Explain tree diagram, trellis diagram and state transition diagram of convolutional code. (6)

14) (a) (i) Define a matched filter and compare its function with a correlation. (10)

(ii) Explain how a matched filter can maximize SNR for a given transmitted signal. (6)

Or

14) (b) What does the term equalization refer to? Explain how it is carried out by using transverse filters. (16)

15) (a) (i) distinguish coherent and non-coherent detection. (4)

(ii) Explain noncoherent detection methods of binary frequency shift keying scheme. (12)

Or

15) (b) (i) Explain binary PSK and QPSK with corresponding equations and constellation diagrams. (8)

(ii) Obtain the probability of bit error rate for coherently detected BPSK and compare its probability of bit error rate performance with QPSK scheme. (8)

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL / MAY 2011

Fifth Semester

Electronics and Communication Engineering

EC 2301 DIGITAL COMMUNICATION

(Regulations 2008)

Time: Three Hours Maximum: 100 marks Answer ALL Questions

Part A (10 * 2 = 20 marks)

1. Give an example each for time limited and time unlimited signals.
2. Give an advantage and disadvantage of digital communication.
3. State sampling theorem.
4. What is quantization error?
5. Define hamming distance.
6. What is mean by transparency with respect to line codes?
7. What is a Matched filter?
8. Give two applications for Eye pattern.
9. Draw the PSK waveform for 011011.
10. What is meant by coherent detection system?

Part B (5*16 = 80 Marks)

11) (a) Explain how PWM and PPM signals are generated.

Or

11(b) (i) Classify channels. Explain the mathematical model of any two communication channels. (Marks 6)

(ii) Explain binary symmetric channel and Gaussian channel with their mathematical Models. (Marks 10)

12) (a) (i) Explain non-uniform quantization process.

(ii) Write notes on temporal waveform coding

Or 12)

(b) (i) Explain spectral waveform encoding process. (ii)

Compare various speeches encoding methods.

13) (a) (i) assume a (2, 1) convolutional coder with constraint length 6. Draw the tree diagram, state diagram and trellis diagram for the assumed coder.

(ii) Find the (7, 4) linear symmetric block code word corresponds to 1101. Assume a suitable generator matrix.

Or

13) (b) Draw the power spectra of polar codes and on-off codes. Discuss their characteristics.

14) (a) Derive the expression for bit error probability due to matched filter.

Or

14) (b) Discuss on signal design for ISI elimination.

15) (a) Derive bit error probability due to coherent ASK, PSK and FSK system. Compare the performance of these systems

Or

15) (b) (i) Discuss QPSK signaling.

(ii) Derive the bit error probability due to QPSK receiver. Compare the performance of QPSK receiver with that of PSK receiver.

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER / DECEMBER 2011.

Fifth Semester

Electronics and Communication Engineering

EC 2301 DIGITAL COMMUNICATION

(Regulations 2008)

(Common to PETC 230 / EC51- Digital Communication for B.E (part-time) fourth semester Electronics and Communication Engineering (Regulation 2009))

Time: Three Hours **Maximum: 100 marks**

Answer ALL Questions

Part A (10 * 2 = 20 marks)

1. Draw the block diagram of digital communication system.
2. Define half power bandwidth
3. Compare uniform and non-uniform quantization
4. What is meant by temporal waveform coding?
5. Mention the properties of cyclic code
6. Draw the RZ-Bipolar linear code format for the information {10110}
7. State Nyquist criterion for zero ISI.
8. Bipolar pulse waveforms ()( ) of amplitude ±1V are received in the presence of AWGN that has a variance of 0.1 V^2. Find the optimum detection threshold of MAP detector, if a priority probability ( )=0.5.
9. Why is PSK always preferable over ASK in coherent detection?
10. Differentiate between coherent and non-coherent detection.

PART B (5*16=80)

11) (a) Explain in detail the Gram-Schmidt orthogonalisation procedure. (16)

Or

(b) Discuss in detail the different mathematical models of communication channels. (16)

12) (a) (i) A television has a bandwidth of 4.5 Mhz. This signal is sampled, quantized and binary coded to obtain a PCM signal.

1) Determine the sampling rate it the signals is to be sampled at a rate 20% above Nyquist rate.

2) If the samples are quantized into 1024 levels, determine the number of binary pulses required to encode each sample.

3) Determine the binary pulse rate of the binary coded signal and the minimum bandwidth required to transmit this signal. (12)

(ii) Compare different speech coding techniques. (4)

Or

(b) (i) Explain the following sampling techniques with necessary waveforms.

1) Impulse sampling (6)

2) Natural sampling (6)

(ii) Write a short note on spectral waveform encoding. (4)

13) (a) (i) Construct a single error correcting linear code and the corresponding decoding table. (10)

(ii) Briefly describe the concept of error free communication. (6)

Or

(b) (i) List and explain the propertied of line codes. (8)

(ii) Determine the generator polynomial g(x) for a (7, 4) cyclic code and find code vectors of the following data vectors 1010, 1111 and 1000. (8)

14) (a) (i) In a certain binary communication system that uses Nyquist criteria pulses, a received pulse Pr(t) has the following values at the sampling instants.

Pr(0) =1, Pr(Tb) = 0.1, Pr(-Tb) = 0.3, Pr(2Tb)=.2 and Pr(-2Tb)=.01. Determine the tap setting of a three tap equalizer. (8)

(ii) explain the working principles of maximum likelihood detector. (8)

Or

(b) Derive the expression for error probability of on-off and polar signaling. (16)

15) (a) Explain the concept of coherent BPSK with transmitter and receiver block diagrams and

obtain the expression for probability of error. (16)

Or

(b) A set of binary data is sent at the rate of Rb=100 kbps over a channel with 60dB transmission loss and power spectral density $\eta=10^{-2}$ w/Hz at the receiver. Determine the transmitted power of error probability $Pe=10^{-3}$ for the following modulation schemes

(i) Non-coherent ASK

(ii) FSK

(iii)PSK

(iv) DPSK

(v) 16 QAM

B.E./B.Tech. DEGREE EXAMINATIONS, MAY / JUNE 2012.

Fifth Semester

Electronics and Communication Engineering

EC 2301 DIGITAL COMMUNICATION

(Regulations 2008)

(Common to PETC 230 / EC51- Digital Communication for B.E (part-time) fourth semester Electronics and Communication Engineering (Regulation 2009))

Time: Three Hours **Maximum: 100 marks**

Answer ALL Questions

Part A (10 * 2 = 20 marks)

1. Define measure of information.
2. What is meant by symmetric channel?
3. State sampling theorem for low pass signals.
4. What is meant by quantization?
5. What is convolutional code? How is it different from block codes?
6. What is Manchester code? Draw the Manchester format for the data stream 10110?
7. What are the properties of matched filter?
8. What are the information that can be obtained from eye pattern regarding the signal quality?
9. What are the drawbacks of binary PSK system?
10. What is meant by coherent and non-coherent detection?

Part B (5*16 = 80 marks)

11. (a) (i) draw the block diagram of digital communication systems and explain each block details. (10)

    (ii) What is uncertainty? Explain the difference between uncertainty and information. (6)

    Or

    (b) (i) Explain the geometric representation of signals. (6)

    (ii) Give the model of discrete-time memoryless Gaussian channel and derive channel capacity for bandlimited additive white Gaussian channel. (10)

12. (a) (i) Explain what is natural sampling and flat-top sampling. (6)

(ii) With neat block diagram, pulse modulation and demodulation system. (10)

Or

(b) (i) Explain the noises in delta modulation systems. How to overcome this effect in Delta modulation? (8)

(ii) Draw the block diagram of adaptive sub-band coding scheme for speech signal and explain. (8)

13. (a) (i) Explain the error detecting and correcting capabilities of linear block codes. (6)

(ii) Consider a (7,4) linear block code whose parity check matrix is given by

[ ]

(1) Find the generator matrix.

(2) How many errors this code can detect?

(3) How many errors can this code be corrected?

(4) Draw circuit for encode3r and syndrome computation. (2+2+2+4)

Or

(b) (i) Explain the transform domain approach analysis of convolutional code. (6)

(ii) derive the power spectral density of polar signaling and explain. (10)

14. (a) (i) state Nyquest's pulse shape criterion for zero ISI and explain. (6)

(ii) draw the block diagram of duo-binary signaling scheme for controlled ISI. Explain the scheme with and without precoder. (10)

Or

(b) (i) Explain zero-forcing equalizer with neat diagram. (10)

(ii) Explain the maximum likelihood detector. (6)

15. (a) (i) Derive the power spectral density of binary ASK signal. (6)

(ii) Draw the block diagram of QPSK transmitter and receiver. Explain the function of various block. (10)

Or

(b) (i) Draw the functional block diagram of modulator for QAM and explain its operation. (8)

(ii) Derive the expression for error-probability of QAM system. (8)

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER / DECEMBER 2012

Fifth Semester

Electronics and Communication Engineering

EC 2301/ EC 51 DIGITAL COMMUNICATION

(Regulations 2008)

(Common to PETC 2301- Digital Communication for B.E (part-time) fourth semester Electronics and Communication Engineering (Regulation 2009))

Time: Three Hours **Maximum: 100 marks**

Answer ALL Questions

Part A (10 * 2 = 20 marks)

1. Draw the typical digital communication system.
2. How can BER of a system to be improved?
3. An analog waveform with maximum frequency content of 3 kHz is to be transmitted over an M-ary PCM system, where M=16. What is the minimum number of bits/sample that should be used in digitizing the Analog waveform? (The quantization error is specified not to exceed ±10% of the peak-to-peak analog signal).
4. Differentiate the principles of temporal waveform coding and model-based coding.
5. Find the Hamming distance between 101010 and 010101. If the minimum Hamming distance of a (n, k) linear block code is 3. What is its minimum Hamming weight?
6. State any four desirable properties of a line code.
7. 64 kbps binary PCM polar NRZ signal is passed through a communication system with a raised-cosine filter with roll-off factor 0.25. Find the bandwidth of a filtered PCM signal.
8. State two applications of eye pattern.
9. A BPSK system makes errors at the average rate of 1000 errors per delay. Data rate is 1 kbps . The single-sided noise power spectral density is 10^{-20} W/Hz. Assuming the system to be wide sense stationary, what is the average bit error probability?
10. What is meant by memory less modulations?

Part B (5*15=80 marks)

11) (a) explain Gram-Schmidt orthogonalisation procedure.

Or

(b) i) Explain any three communication models. (12)

ii) Sate the advantages and disadvantages of a communication system. (4)

12) (a) Explain a DPCM system. Derive the expression for the slope overload noise of the system. Show that SNR of DPCM is better than that of PCM.

Or

(b) i) Explain subband coding.(8)

ii) Compare the performance of various speech encoding methods. (8)

13) (a) Derive the expression for power spectral density of unipolar NRZ line code. Hence discuss its characteristics.

Or

(b) i) Design a block code for a message block of size eight that can correct or single errors. (6)

ii) Design a convolutional code of constraint length 6 and rate ½. Draw its tree diagram and trellis diagram (10)

14) (a) Explain modified duo-binary signaling scheme without and with precoder.

Or

(b) Explain the working of Correlator type receiving filtering.

15) (a) Discuss the representation and spectral characteristics of ASK, PSK, QAM, QPSK and FSK signals.

Or

(b) Compare the performance of various coherent and non-coherent digital detection systems.