Course Plan

Semester: **6 - Semester**	Year: **2019**
Course Title: **DIGITAL COMMUNICATION**	Course Code: **EC114**
Semester End Examination : **70**	Continuous Internal Evaluation: **30**
Lesson Plan Author: Mr. S SRINIVAS	Last Modified Date: 25-11-2018

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Apply different sampling techniques to convert analog signal to discrete sequence
2. Compute signal-to-noise ratio in various pulse modulation techniques
3. Construct solution for inter symbol interference in band limited channels
4. Evaluate probability of error in various digital modulation techniques
5. Describe the applications of spread spectrum..

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO-1	PSO-2
1. Apply different sampling techniques to convert analog signal to discrete sequence	**3**	**1**											**2**	
2. Compute signal-to-noise ratio in various pulse modulation techniques	**3**	**2**											**1**	
3. Construct solution for inter symbol interference in band limited channels	**2**	**1**	**1**										**2**	
4. Evaluate probability of error in various digital modulation techniques	**3**	**2**											**2**	
5. Describe the applications of spread spectrum..	**1**	**1**											**1**	

Course Content

Content	Hrs
Unit – 1	
Chapter No. 1 - Introduction to Digital Communication Systems Block diagram of digital communication system, Channel capacity, Shannon's limit, sampling Theorem -Mathematical proof of sampling and reconstruction – ideal and Flat top sampling, Band pass sampling	8.00 hrs
Unit – 2	
Chapter No. 2 - Pulse digital modulation : Pulse code modulation, generation and detection of PCM, Uniform quantization and companding, Differential PCM; Delta modulation, Adaptive delta modulation; Signal-to- Noise Ratio calculations in PCM, DM	8.00 hrs
Unit – 3	
Chapter No. 3 - Base band data transmission: Communication over Band limited AWGN Channel, ISI in band limited channels, Zero-ISI condition- the Nyquist criterion, Solution for zero ISI, Raised cosine filters, Partial response signalling-Duo binary encoding, M-ary baseband system, eye pattern, adaptive Equalization.	8.00 hrs
Unit – 4	
Chapter No. 4 - Digital carrier modulation schemes Optimum Receiver for AWGN channel, Matched filter and Correlation receivers, Digital Modulations-Techniques, Generation and detection of ASK, BPSK and BFSK, QPSK and DPSK, probability of bit error computation for BPSK, BFSK, QPSK, M-ary signalling schemes, comparison of Modulation techniques	13.00 hrs
Unit – 5	
Chapter No. 5 - Spread spectrum modulation Need for Spread Spectrum Modulation, PN sequence and its properties, Direct sequence SS system- DS/BPSK Transmitter & Receiver, Processing gain, Jamming margin, Frequency hop SS system- FH-FSK transmitter and Receiver, Fast and slow hop, Application of SS, CDMA, Multipath fading.	8.00 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Sam Shanmugam, Digital and analog communication system, John Wiley, 2005
2. Herbert Taud, Donald L. Schiling, Goutam Saha, Principles of Communication Systems, 3rd , Mc GrawHill , 2008

References

1. Simon Haykin, Digital communications, John Wiley, 2005
2. Wayne Tomasi , Electronic communications systems, 5th, pearson publication

Chapterwise Plan

Course Code and Title: **EC114 / DIGITAL COMMUNICATION**	
Chapter Number and Title: **1 - Introduction to Digital Communication Systems**	Plan

Learning Outcomes:-
At the end of the topic the student should be able to:

	Topic Learning Outcomes
1	Distinguish between analog and digital communication systems.
2	Describe different communication channels and compute channel capacity.
3	Explain about the Shannon's limit for information capacity
4	Recall different types of sampling techniques adopted for low pass signals i.e statement and proof of id
5	Analyze the Reconstruction theorem to recover the low pass signals.

Lesson Schedule

Lecture No. - Portion covered per hour
1. Introduction to Digital Communication Systems, Advantages, disadvantages, applications.
2. Block diagram of digital communication system.
3. Communication Channels, Channel capacity
4. Shannon\'s limit
5-6. Sampling theorem- Mathematical proof(ideal and flat top).
7-8. Reconstruction Theorem, Band Pass Sampling

Review Questions

Sl.No. - Questions
1. Sketch and explain model of Digital communication system
2. State and prove the sampling theorem for Low pass signals.
3. A signal m(t) = cos(200pt) + 2 cos(320pt) is ideally sampled at fS = 300Hz. If the sampled signal is passed cutoff frequency of 250Hz. compute frequency components will appear in the output?
4. Describe different communication channels.
5. Explain Shannon capacity theorem
6. A black and white TV picture consists of about 2x106 picture elements with16 different brightness levels, w are repeated at the rate of 32 per second, calculate average rate of information conveyed by this T.V picture so maximum bandwidth required to support the transmission of the resultant video signal.
7. A card is drawn from a deck of playing cards .a) You are informed that the card you drawn is a spade. How m (in bits)?b) How much information do you receive if you are told that the card that you drew is an Ace? How mu you are told that the card you drew is an ace of spades? Is the information content of the message "Ace of spa contents of the messages "Spade" and "Ace".

Course Code and Title: **EC114 / DIGITAL COMMUNICATION**

Chapter Number and Title: **2 - Pulse digital modulation :**	Plann

Learning Outcomes:-
At the end of the topic the student should be able to:

	Topic Learning Outcomes
1	Discuss about generation and detection of Pulse Code Modulated signals.
2	Explain in detail the concept of uniform and non-uniform quantization.
3	Describe Differential PCM, DM, and ADM.
4	Compare Delta Modulation and Adaptive DM techniques.
5	Compute S/N for PCM and DM signals.

Lesson Schedule

Lecture No. - Portion covered per hour
9. Pulse code modulation, generation and detection of PCM,
10. Uniform quantization
11. Companding, Coding
12. Signal-to- Noise Ratio calculations in PCM.
13. DPCM
14. Delta Modulation
15. Adaptive DM.
16. Noise in PCM and DM

Review Questions

Sl.No. - Questions
1. Describe with a neat block diagram the operation of a continuously variable slope delta modulator (ADM).
2. Compare Delta modulation with Pulse code modulation technique
3. Explain about Non uniform Quantization
4. Distinguish between Differential PCM and PCM
5. A DM system is designed to operate at three times the Nyquist rate for a signal with 3 kHz bandwidth mV.a).Compute the maximum amplitude of a 1 kHz input sinusoid for which the delta modulator does not sho post filtered output SNR for the signal of part (i).
6. Describe about Delta modulation and demodulation.
7. Sketch the block diagram of PCM and explain
8. Consider a speech signal with maximum frequency of 3.4 KHz and maximum Amplitude of 1v.This speech rate is set at 20kbps. Identify an appropriate step size for the modulator.
9. Make use of DPCM to Build Delta modulation

10. It is required to transmit telephone messages across the United states, a 3000 mile run. The signal level is millivolt before amplification and the signal is not to be allowed to be larger than 15 volts in order to avoid repeaters are to be located with equal spacing's how many repeaters are required.

Course Code and Title: **EC114 / DIGITAL COMMUNICATION**	
Chapter Number and Title: **3 - Base band data transmission:**	Plann

Learning Outcomes:-
At the end of the topic the student should be able to:

	Topic Learning Outcomes
1	Interpret inter symbol interference over Band limited channels.
2	State the conditions for zero ISI and analyze solutions for zero ISI.
3	Explain about duo-binary signaling scheme with an example
4	Explain how an eye pattern is used for the analysis of ISI.
5	Discuss the concept of adaptive equalization used to overcome ISI.

Lesson Schedule

Lecture No. - Portion covered per hour
17. Communication over Band limited AWGN Channel,
18. ISI in band limited channels
19. Zero-ISI condition- the Nyquist criterion
20. Solution for zero ISI, Raised cosine filters,
21. Partial response signalling-Duo binary encoding.
22. Modified Duo binary system
23. M-ary baseband system, eye pattern
24. Adaptive Equalization

Review Questions

Sl.No. - Questions
1. Describe ISI in Base band Data transmission.
2. Define Equalization and discuss Adaptive Equalization.
3. Compute ideal solution to obtain zero ISI and identify the disadvantage of this solution
4. Illustrate eye diagram.
5. Analyze about Duo binary signaling systems.
6. Explain about M-ary signaling scheme.
7. Identify the problem of ISI in Baseband transmission and construct appropriate solution for it.

8. A computer put out binary data at the rate of 56 Kbits/sec. the computer output is transmitted using a base designed to have a raised cosine spectrum .Solve for the transmission bandwidth required for each of the followi = 0.5 c) α = 0.75 d) α = 1.0.
9. A binary wave form using polar signaling is generated by representing symbol 1 by a pulse of amplitude + amplitude -1V; in both the cases the pulse duration equals the bit duration. this signal is applied to a low-pass Construct the eye pattern for the filter output for the following sequences a) Alternating 1s and 0s.b) A long se sequence of 0s.c) A long sequence of 1s followed by a single 0 and then a long sequence of 1s.

Course Code and Title: **EC114 / DIGITAL COMMUNICATION**	
Chapter Number and Title: **4 - Digital carrier modulation schemes**	Plann

Learning Outcomes:-
At the end of the topic the student should be able to:

	Topic Learning Outcomes
1	Design Optimum Receiver for AWGN channel
2	Compare Matched filter and Correlation receivers.
3	Describe the generation and detection of digital modulation techniques such as ASK, BPSK, BFSK wi
4	Compute the probability error of ASK, BPSK,BFSK
5	Explain Mary signaling schemes like QPSK.

Lesson Schedule

Lecture No. - Portion covered per hour
29. Optimum Receiver for AWGN channel.
30. Matched filter and Correlation receivers.
31. Digital Modulations-Techniques, Generation and detection of ASK,
32. Probability of bit error computation for ASK.
33. Generation and detection of BPSK
34. Probability of bit error computation for BPSK.
35. Generation and detection of BFSK
36. Probability of bit error computation for BFSK.
37. M-ary signalling schemes, QPSK
25-26. Probability of bit error computation for QPSK.
27-28. DPSK and comparison of Modulation techniques.

Review Questions

Sl.No. - Questions
1. sketch and explain QPSK transmitter and Receiver

2. Evaluate the error probability for QPSK and PSK
3. Discuss in brief about matched filter
4. Explain ASK Modulator, Coherent ASK and Non-Coherent Detector and .evaluate the error probability for AS
5. Sketch the Frequency Spectrum of BFSK.
6. Distinguish between coherent and Non coherent FSK Detection,
7. Describe Differential PSK with an example
8. Evaluate the error probability for PSK
9. Design an optimum filters for base band transmission.
10. Compute the error probability for FSK
11. Evaluate the impulse response of matched filter.
12. Make use of an Optimum receiver to find out the probability of error of different modulation techniques.
13. Compare the outputs of the matched filter and correlator , what the input signal is either +V, as a function o Gaussian noise. Are the outputs same for all t , or just when t=T?

Course Code and Title: **EC114 / DIGITAL COMMUNICATION**	
Chapter Number and Title: **5 - Spread spectrum modulation**	Plann

Learning Outcomes:-
At the end of the topic the student should be able to:

	Topic Learning Outcomes
1	Explain the need of spread spectrum modulation technique.
2	Explain the properties and generation of PN sequence used for Spread spectrum modulation.
3	Describe DSSS system and list out its applications.
4	Describe the Fast and Slow FHSS systems and list out its applications.
5	Explain the concept of Multipath Fading.

Lesson Schedule

Lecture No. - Portion covered per hour
38. Need for Spread Spectrum Modulation, Applications
39. Processing gain, Jamming margin.
40. PN sequence and its properties, examples.
45. Direct sequence SS system- DS/BPSK Transmitter & Receiver.
41-42. Frequency hop SS system- FH-FSK transmitter and Receiver, Fast and slow hop
43-44. CDMA, Multipath fading.

Review Questions

Sl.No. - Questions
1. Describe Code Division Multiple Access
2. Describe the applications of Spread Spectrum in detail.
3. Explain Frequency Hopping Spread spectrum in detail.
4. Evaluate PN – sequences for ‘n’ number of bits.
5. Analyze the performance of Direct Sequence Spread Spectrum with an example.
6. Apply Direct sequence spread spectrum to find the range of an aircraft with chip rate =2 Mb/s and assume T1=
7. A PN sequence is generated using a feedback shift register of length M = 4, the chip rate is 107 chip/sec, Solv PN sequence lengthChip duration of PN sequence