Techno India NJR Institute of Technology

Academic Administration of Techno NJR Institute

Syllabus Deployment

Name of Faculty: Dr. Vivek Jain Subject Code:DCIT

Subject Name: Digital Communication &Information Theory SEM: V

Department: Department of Electronics and Communication Engineering

Total No. of Lectures Planned: 40

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Scheme & Syllabus

IV Year- VII & VIII Semester: B. Tech. (Electrical and Electronics Engineering)

8EX4-01: DIGITAL COMMUNICATION AND INFORMATION THEORY

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**PCM & DELTA Modulation Systems:**PCM and delta modulation, quantization noise in PCM and delta modulation. Signal-to-noise ratio in PCM and delta modulation,T1 Carrier System, Comparison of PCM and DM. Adaptive delta Modulation. Bit, word and frame synchronization, Matched filter detection.	08
3	**Digital Modulation Techniques:** Various techniques of phase shift, amplitude shift and frequency shift keying. Minimum shift keying. Modulation & Demodulation.	07
4	**Error Probability in Digital Modulation:** Calculation of error probabilities for PSK, ASK, FSK & MSK techniques.	08
5	**Information Theory:**Amount of Information, Average Information, Entropy, Information rate, Increase in Average information per bit by coding, Shannon's Theorem and Shannon's bound Capacity of a Gaussian Channel, BW-S/N trade off, Orthogonal signal transmission.	08
6	**Coding:** Coding of Information, Hamming code, Single Parity-Bit Code, Linear Block code, cyclic code &convolution code.	08
	TOTAL	40

Text/Reference Books	
1	Sklar: Digital Communication, Pearson Education. 2009
2	R. N. Mutagi: Digital Communication, 2nd ed., Oxford. 2013
3	P. Ramakrishna Rao: Communication Systems, MGH. 2013
4	H. Taub & D.L. Schilling: Principles of Communication Systems, MGH. 2008
5	Proakis: Digital Communication, MGH. 2008
6	P. Chakrabarti: Principles of Digital Communications, Danpatrai & Sons. 1999
7	K. Sam Shanmugam: Digital and Analog Communication System, John Wiley Sons. 2006
8	Lathi, B. P.: Modern Digital &Analog Communication System, Oxford Press. 2009

Course Overview:

Student will learn fundamentals of Analog and Digital communication from this 40-hour course. In this course, student will study the fundamental concepts and application of different analog and digitalsystems. Also, they will learndifferent modulation techniques used in various communication system.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	Knowledge	Analyze and compare different analog modulation schemes for their efficiencyand bandwidth
2	Application	Analyze the behavior of a communication system in presence of noise
3	Analysis	Investigate pulsed modulation system and analyze their system performance
4	Synthesis	Analyze different digital modulation schemes and can compute the bit error performance
5	Synthesis	Design a communication system comprised of both analog and digital modulation techniques

Prerequisites:

1. Fundamentals of various signal types.
2. Must have completed the course on signal and systems.
3. Student should be able to solve the problems of various transforms.

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific					Domain Independent						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		3		1				1		
CO2	3	2		3		1						
CO3	3	2		3		2						
CO4	3	3		3		2				1		
CO5	3	2	3	3		3			2	2		

1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	**1**	**DIGITAL TRANSMISSION OF ANALOG SIGNALS**
2	1	Uniform and Non-uniform quantization
3	1	PCM and delta modulation
4	1	Signal to quantization noise ratio in PCM modulation
5	1	Signal to quantization noise ratio in delta modulation
6	1	DPCM
7	1	ADM
8	1	T1 Carrier System, Errorprobability in PCM system
9	**2**	**BASE BAND TRANSMISSION**
10	2	Line coding (RZ, NRZ)
11	2	Polar, Bipolar,Manchester
12	2	AMI. Inter symbol interference
13	2	Pulse shaping, Nyquistcriterion
14	2	Raised cosine spectrum
15	2	Optimum detection
16	2	Matched filter.
17	**3**	**DIGITAL MODULATION TECHNIQUES:** Geometric interpretation of signals andOrthogonalization
18	3	ASK ,BPSK Modulation and Demodulation
19	3	FSK Modulation and Demodulation
20	3	QPSK Modulation and Demodulation
21	3	M-ary PSK, MSKModulation and Demodulation
22	3	GMSKModulation and Demodulation
23	3	Calculation of error probabilities of ASK,FSK,BPSK
24	3	Calculation of error probabilities of QPSK,M-ary PSK,MSK
25	**4**	**INFORMATION THEORY:** Measure of Information
26	4	Average Information
27	4	Entropy, Information rate
28	4	Increase in Average information per bit bycoding
29	4	Shannon'sTheorem and Shannon's bound
30	4	Capacity of a Gaussian Channel

31	4	Capacity of a Gaussian Channel
32	4	BW-S/Ntrade off
33	**5**	**SOURCE & ERROR CONTROL CODING**
34	5	Coding and decoding of InformationSource coding
35	5	Entropy coding, Hamming code,Single Parity- Bit Code
36	5	Linear Block code
37	5	Linear Block code
38	5	Cyclic code
39	5	Cyclic code
40	5	Convolutional code

TEXT/REFERENCE BOOKS

1. Digital Communications Systems, P RamaKrishna Rao, Mc Graw Hill
2. Digital Communications Systems, Simon Haykins, Wiley
3. Digital & Analog Communication Systems, Leon W. Couch, Pearson.
4. Digital And Analog Communication Systems, Shanmugam, Wiley.

Teaching and Learning resources:

- **MOOC (NPTEL): -** https://nptel.ac.in/courses/117/105/117105143/

https://nptel.ac.in/courses/117/101/117101051/

Assessment Methodology:

1. Practical exam using lab instruments.
2. Two Midterm exams where student have to showcase subjective learning.
3. Final Exam (subjective paper) at the end of the semester.

For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

UNIT- I

Q.1 (a) What is meant by Quantization? Explain the need of quantization of signals and derive an expression for Quantization error. [10]

(b) An audio signal, $s(t) = 3\cos(2\pi\ 500\ t)$ is Quantized using 10-bit PCM. Determine the signal-to-Quantization noise ratio. [6]

OR

Q.1 (a) With neat diagram, explain the adaptive delta modulation and demodulation system in detail. [8]

(b) Compute the Signal-to-Noise Power Ratio (SNR) for PCM and DM system for specified probability of error (P_e) as 10^{-6}. Assume n = 8 in a code word. Comment on the result. [8]

UNIT- II

Q.2 (a) Give the classification hierarchy of line encoding techniques. Discuss the comparative advantages and disadvantages of unipolar NRZ, bipolar RZ, and bipolar AMI-RZ signaling line code formats. [8]

(b) Plot the output waveform of a baseband quaternary PAM system for the input binary data sequence 0010110111. [8]

OR

Q.2 (a) A matched filter has the frequency response- [10]

$$H(f) = \frac{1 - e^{-j2\pi ft}}{j2\pi f}$$

(i) Determine the impulse response h(t).

(ii) Determine the signal waveform to which the filter characteristics are matched.

(b) Discuss the effects of Inter Symbol Interference (ISI) on the performance of digital transmission. [6]

UNIT- III

Q.3 (a) Draw the signal constellation of a binary FSK modulation scheme. Draw the block diagrams of generation and detection of coherent binary FSK signals. [10]

(b) In a BPSK digital communication system, the bit rate of a bipolar NRZ data sequence is 1 Mbps and carrier frequency of transmission is 100MHz. Determine the symbol rate of transmission and the bandwidth requirement of the communication channel. [6]

OR

Q.3 (a) Derive the relation for the average probability of symbol error for coherent M-ary PSK. [8]

(b) Explain the difference between coherent and non-coherent detection. Also sketch the signal constellation of a QPSK modulator. [8]

UNIT- IV

Q.4 (a) State and explain Shannon-Hartley theorem on channel capacity and its implications. [8]

(b) Consider a telegraph source having two symbols, dot and dash. The dot duration is 0.2s. The dash duration is 3 times the dot duration. The probability of the dot's occuring is twice that of the dash, and the time between symbol is 0.2s. Calculate the information rate of the telegraph source. [8]

OR

Q.4 (a) Describe trade-off between SNR and bandwidth of a channel capacity (expressed in bits per seconds) is maintained constant. [8]

(b) A DMS has five symbols x_1, x_2, x_3, x_4 and x_5 with $P(x_1) = 0.4$, $P(x_2) = 0.19$, $P(x_3) = 0.16$, $P(x_4) = 0.15$, and $P(x_5) = 0.1$. [8]

(i) Construct a Shannon-Fano code for x, and calculate the efficiency of the code.

(ii) Repeat for the Huffman code and compare the results.

UNIT- V

Q.5 (a) What are Hamming codes? How many errors can be detected and corrected with the help of these codes? Explain with example. [8]

(b) A parity-check code has the parity- check matrix- [8]

$$H = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(i) Determine the generator matrix G.

(ii) Find the code word that begins 101....

(iii) Suppose that the received word is 110110.

Decode this received word.

OR

OR

Q.5 (a) Discuss the error detecting and error correcting capabilities of convolution codes. [8]

(b) Let C be a (7, 4) cyclic code with $g(x) = 1 + x + x^3$. Find a generator matrix G for C and final the code word for d = (1 0 1 0). [8]
