INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500043

## ELECTRONICS AND COMMUNICATION ENGINEERING

ASSIGNMENT QUESTIONS

| Course Name | DIGITAL COMMUNICATIONS |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
| Course Code | A60420 | Tutorials | Practicals | Total |
| Course Structure | Lectures | $\mathbf{1}$ | - |  |
|  |  |  |  |  |
| Course Coordinator | Dr. P. G. Krishna Mohan, Professor, ECE Dept |  |  |  |
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## OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

| ASSIGNMENT I |  |  |  |
| :---: | :--- | :---: | :---: |
| UNIT I |  |  |  |
| ELEMENTS OF DIGITAL COMMUNICATION SYSTEMS PULSE CODE MODULATION |  |  |  |\(\left|\begin{array}{c}Blooms <br>

Taxonomy <br>
Level\end{array} \quad $$
\begin{array}{c}\text { Course } \\
\text { Outcome }\end{array}
$$\right|\)

| 12 | Estimate Nyquist rate and Nyquist interval for the signal 10 $\operatorname{Cos}(2000 \pi t) \operatorname{Cos}(4000 \pi t)$ based on Low pass sampling theory | Understand | 5 |
| :---: | :---: | :---: | :---: |
| 13 | Solve the Nyquist rate and Nyquist intervals for each of the following signals <br> i) $x(t)=\operatorname{Sinc} 200 t$ <br> ii) $x(t)=\operatorname{Sinc} 200 t$ <br> iii) $x(t)=$ Sinc200t+Sinc200t. | Understand | 5 |
| 14 | The terminal of a computer used to enter alphanumeric data is connected to the computer through a voice grade telephone line having a usable bandwidth of 3 KHz and a output SNRof 10 dB . Determine the capacity of the channel. | Remember | 8 |
| 15 | For a DM system, signal sampled at 76 KHz and $\mathrm{Amax}=4$ (a)Assuming that the signal is sinusoidal determine output signal power \& SNR. <br> (b)Determine the minimum transmission Band width? Deriv the relations. | Understand | 1 |
| 16 | The input to the PCM system is $\mathrm{m}(\mathrm{t})=10 \cos 2 \pi \times 104 \mathrm{t}$, the signal is sampled at nyquist rate, each sample is encoded in to 4-bits. Determine <br> i) Bit rate <br> ii) Bandwidth, iii)Signal to Noise ratio | Understand | 2 |
| 17 | The input to the $D M$ is $m(t)=8 \sin 2 \pi x 104 \mathrm{t}$. The step size $\delta=0.314$ volts. Determine the bit rate. | Understand | 1 |
| 18 | Explain the Block diagram of DPCM system. | Remember | 2 |
| 19 | Elaborate how to avoid slope overload distortion in DM. | Remember | 4 |
| 20 | Illustrate the working of Adaptive DPCM with the help of diagram. | Remember | 3 |
| 21 | Illustrate the working of Adaptive DM with the help of diagram. | Remember | 5 |
| 22 | Explain the Companding. | Remember | 5 |
| 23 | A TV signal with a bandwidth of 4.2 MHz is transmitted using PCM with 512 quantization levels. Solve binary word code length and transmitted bit rate. | Remember | 8 |
| 24 | The input to the delta modulator is $\mathrm{m}(\mathrm{t})=5 \mathrm{t}$ and sampling rate is $5000 \mathrm{samples} / \mathrm{sec}$. Determine the step size. | Understand | 1 |
| 25 | Define quantization noise power | Remember | 2 |
| 26 | Discuss about uniform quantization? | Remember | 4 |
| UNIT IIDIGITAL MODULATION TECHNIQUES |  |  |  |
| S. No. | Questions | $\begin{gathered} \text { Blooms } \\ \text { Taxonomy } \\ \text { Level } \end{gathered}$ | Course Outcome |
| 1 | Explain in detail about <br> i. FSK <br> ii. PSK with waveforms and equations | Remember | 5 |
| 2 | Determine probability of error for <br> a) ASK <br> b) PSK systems. | Remember | 8 |
| 3 | What are eye pattern? | Remember | 1 |
| 4 | Explain Optimum Receiver. | Remember | 2 |
| 5 | Examine Crosstalk. | Remember | 4 |
| 6 | Estimate the band width required for frequency shift keying and draw its spectrum. | Remember | 3 |
| 7 | Explain non coherent detection of Amplitude shift keying. | Remember | 5 |
| 8 | Construct the constellation diagram for Quadrature phase shift keying. | Remember | 5 |


| 9 | Explain coherent detection of frequency shift keying .what should be the relationship between bit rate and frequency shift for a better performance? | Remember | 8 |
| :---: | :---: | :---: | :---: |
| 10 | Explain Differential phase shift keying modulation with neat block diagram. Draw the wave forms. | Remember | 1 |
| 11 | Show that the probability of error for phase shift keying is $\mathrm{Pe}=\mathrm{Q}(2 \mathrm{Sav} \mathrm{Tb} / \mathrm{N} 0) 1 / 2$ and the threshold level is zero. | Understand | 2 |
| 12 | The bit stream 11011100101 is to be transmitted using DPSK. Determine the encoded sequence and the transmitted phase sequence. | Understand | 4 |
| 13 | Explain the working of DPSK modulator and demodulator. | Remember | 3 |
| UNIT III <br> BASE BAND TRANSMISSION AND OPTIMAL RECEPTION OF DIGITAL SIGNAL INFORMATION THEORY |  |  |  |
| S. No. | Questions | Blooms Taxonomy Level | Course Outcome |
| 1 | Why equalization is necessary in Baseband transmission? Give the block diagram of adaptive filter and explain about each element. | Remember | 8 |
| 2 | Explain the base band transmission of M-ary data with suitable diagrams. | Remember | 1 |
| 3 | What is matched filter? Derive the expression for its output SNR. | Remember | 2 |
| 4 | a) What is an inter symbol interference in baseband binary PAM system? Explain. <br> b) Give the basic components of a filter in baseband data transmission and explain. | Understand | 4 |
| 5 | 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 $\alpha=0.25$. | Remember | 3 |
| 6 | 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 $\alpha=0.2$ are used the sampling rate must be at least $25 \%$ above the Nyquist rate. <br> A telephone line of bandwidth 4 Khz required to transmit data at 6 kbps using raised cosine pulses. Determine the roll of factor $\alpha$ | Understand | 5 |
| 7 | Explain Pulse Shaping for Optimum Transmission. | Remember | 5 |
| 8 | Explain A Baseband Signal Receiver. | Remember | 8 |
| 9 | Explain Optimum Receiver | Remember | 1 |
| 10 | Examine Crosstalk. | Remember | 2 |
| 11 | Explain Optimum Receiver. | Remember | 1 |
| 12 | Explain Signal Space Representation. | Understand | 2 |
| 13 | What does the width of the eye define? | Remember | 4 |
| 14 | Why equalization is necessary in Baseband transmission? Give the block diagram of adaptive filter and explain about each element. | Remember | 5 |
| 15 | Explain the base band transmission of M-ary data with suitable diagrams. | Understand | 5 |


| 16 | What is matched filter? Derive the expression for its output SNR. | Understand | 5 |
| :---: | :---: | :---: | :---: |
| ASSIGNMENT II |  |  |  |
| UNIT III <br> BASE BAND TRANSMISSION AND OPTIMAL RECEPTION OF DIGITAL SIGNAL INFORMATION THEORY |  |  |  |
| S. No. | Questions | Blooms Taxonomy Level | Course Outcome |
| 1 | State the properties of Entropy. | Remember | 5 |
| 2 | What is discrete memory less channel and give the channel matrix expression. | Understand | 8 |
| 3 | What is channel coding theorem and how it is different from source coding theorem? | Remember | 1 |
| 4 | What is entropy? Show that the entropy is maximum when all the symbols are equi probable. Assume $\mathrm{M}=2$. | Remember | 2 |
| 5 | Show that the mutual information of a channel is related to the joint entropy of the channel input and channel output. | Remember | 4 |
| 6 | Explain Shannon-fano coding algorithm using an example. | Understand | 3 |
| 7 | Explain the Huffman coding algorithm using an example. | Remember | 5 |
| 8 | Explain the Conditional Entropy. | Remember | 5 |
| 9 | Explain the Redundancy. | Remember | 8 |
| 10 | A voice signal is sampled at the rate of 5000 samples/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 <br> a) ASK <br> b) PSK <br> c) FSK <br> where $\mathrm{f} 1=8 \mathrm{MHz}$ and $\mathrm{f} 2=6 \mathrm{MHz}$. | Understand | 1 |
| 11 | Binary data is transmitted over an RF band pass channel with a usable bandwidth of 10 MHz at a rate of $4.8 \times 106 \mathrm{bits} / \mathrm{sec}$ using an ASK signaling method. The carrier amplitude at the receiver antenna is 1 mV and noise power spectral density at the receiver input is $10-15 \mathrm{Watt} / \mathrm{Hz}$. Determine the error probability of a coherent receiver. | Understand | 2 |
| 12 | Assume that $4800 \mathrm{bits} / \mathrm{sec}$ random data are sent over band pass channel by using the following schemes: <br> a) BPSK <br> b) FSK <br> Determine the Transmission bandwidth. | Remember | 5 |
| UNIT-IVLINEAR BLOCK CODES, CYCLIC CODES \& CONVOLUTIONAL CODES |  |  |  |
| S. No. | Questions | Blooms Taxonomy Level | Course Outcome |
| 1 | The polynomial $\mathrm{x}^{15}+1$ when factored gives $\mathrm{x}^{15}+1=(\mathrm{x} 4+\mathrm{x} 3+1)(\mathrm{x} 4+\mathrm{x} 3+\mathrm{x} 2+\mathrm{x}+1)(\mathrm{x} 4+\mathrm{x}+1)(\mathrm{x} 2+\mathrm{x}+1)(\mathrm{x}+1)$ <br> a) Construct a systematic $(15,5)$ code using the generator polynomial $g(x)=(x 4+x 3+x 2+x+1)(x 4+x+1)(x 4+x 3+1)(x+1)$ <br> b) What is the minimum distance of the code? <br> c) How many random errors per code word can be corrected? | Understand | 2 |
| 2 | The generator polynomial of a $(7,4)$ cyclic code is $\mathrm{g}(\mathrm{x})=$ $1+x+x^{3}$. Find the 16 code words of this code: <br> a) By forming the code polynomials using $\mathrm{v}(\mathrm{x})=\mathrm{D}(\mathrm{x}) \mathrm{g}(\mathrm{x})$, | Understand | 4 |


|  | where $\mathrm{D}(\mathrm{x})$ is the message polynomial. <br> b) Draw the encoder block diagram? |  |  |
| :---: | :---: | :---: | :---: |
| 3 | For a $(6,3)$ systematic linear block code the three parity check bits $\mathrm{c} 4, \mathrm{c} 5$, c6 are formed from the following equations: $\mathrm{c} 4=\mathrm{d} 1$ (xor) $\mathrm{d} 3 ; \mathrm{c} 5=\mathrm{d} 1$ (xor) d2 (xor) d3; c6= d1 (xor) d2. <br> a) Write down the generator matrix $G$ <br> b) Suppose that the received word is 010111 . Decode this received word by finding the location of the error and the transmitted data bit | Understand | 3 |
| 4 | For a $(6,3)$ systematic linear block code, the three parity check bits c4, c5, c6 are formed from the following equations. $\begin{aligned} & \mathrm{C} 4=\mathrm{d} 1+\mathrm{d} 3 \\ & \mathrm{C} 5=\mathrm{d} 1+\mathrm{d} 2+\mathrm{d} 3 \\ & \mathrm{C} 6=\mathrm{d} 1+\mathrm{d} 2 \end{aligned}$ <br> a) Construct the generator matrix G. <br> b) Construct all possible code words. | Understand | 5 |
| 5 | $\begin{gathered} \text { Consider the }(8,4) \text { linear block code with } \mathrm{G}= \\ 100001111 \\ 0100011111 \\ 001000011 \\ 0000101101 \end{gathered}$ <br> (a) Construct all the possible code words <br> (b) Construct all the single error patterns. | Remember | 5 <br>  <br>  |
| 6 | Analyze and prove the fundamental properties of cyclic code. | Remember | 8 |
| 7 | Show that if ci and cj are two code vectors in an ( $\mathrm{n}, \mathrm{k}$ ) linear block code, then their sum is also a code vector. | Remember | 1 |
| 8 | The generator polynomial of $(15,11)$ cyclic code is $\mathrm{g}(\mathrm{x})=$ $1+\mathrm{x}+\mathrm{x} 4$. Determine the parity polynomial $\mathrm{h}(\mathrm{x})$ of this code. | Understand | 2 |
| 9 | What is parity check matrix and how it is used? | Remember | 5 |
| 10 | Explain systematic cyclic code generation formula | Remember | 8 |
| 11 | What are the conditions to satisfy the hamming code? | Remember | 1 |
| 12 | Define code word \& block length. | Understand | 2 |
| 13 | Construct the graphical representations of convolutional codes. | Understand | 4 |
| 14 | Construct the encoding diagram for $(3,2,1)$ convolutional encoder. | Remember | 3 |
| 15 | What is sequential decoding? | Remember | 5 |
| 16 | Explain about the Convolutional interleaving. | Remember | 5 |
| 17 | What is meant by random errors and burst errors? Explain about a coding technique which can be used to correct both the burst and random errors simultaneously. | Remember | 8 |
| 18 | Discuss about the various decoders for convolutional codes. | Remember | 1 |
| 19 | Explain how the channel coding reduces the probability of error. | Remember | 2 |
| 20 | Explain the systematic code form for the binary cyclic codes? | Remember | 5 |
| 21 | Explain about block codes in which each block of k message bits encoded into block of $\mathbf{n}>\mathbf{k}$ bits with an example. | Understand | 8 |
| 22 | Demonstrate the Viterbi algorithm for maximum-likelihood decoding of convolutional codes. | Understand | 1 |
| 23 | Consider the ( $3,1,2$ ) nonsystematic convolution encoder with $\mathrm{g}^{(0)}=(1,1,0), \mathrm{g}^{(1)}=(1,0,1), \mathrm{g}^{(2)}=(1,1,1)$. What the generator matrix for this code. | Understand | 2 |


| 24 | Consider the ( $3,1,2$ ) nonsystematic convolution encoder with $\mathrm{g}^{(0)}=(1,1,0), \mathrm{g}^{(1)}=(1,0,1), \mathrm{g}^{(2)}=(0,1,1)$. Find the constraint length and the rate efficiency of the code. | Remember | 4 |
| :---: | :---: | :---: | :---: |
| 25 | Find the code word for data word 1110 in a $(7,4)$ cyclic code using the generator polynomial $\mathrm{g}(\mathrm{x})=1+\mathrm{x} 2+\mathrm{x} 3$ using encoder. | Remember | 3 |
| UNIT-V <br> SPREAD SPECTRUM MODULATION |  |  |  |
| S. No. | Questions | Blooms Taxonomy Level | Course Outcome |
| 1 | a) Explain how PN sequences are generated. What are maximal-length sequences? What are their properties and why are they preferred? <br> b) With the help of a neat block diagram, explain the working of a DS spread spectrum based CDMA system. | Remember | 8 |
| 2 | Compare direct sequence spread spectrum and frequency hopped spread spectrum techniques and draw the important features of each. | Remember | 2 |
| 3 | a) What the PN sequences? Discuss the characteristics. <br> b) What are the two basic types of spread-spectrums systems? <br> Explain the basic principle of each of them. | Remember | 5 |
| 4 | Explain the spread spectrum modulation. | Understand | 8 |
| 5 | Explain the frequency hopping spread spectrum modulation. | Remember | 1 |
| 6 | Examine spread spectrum modulation using DSSS. | Remember | 4 |
| 7 | Explain the spread spectrum modulation. | Remember | 3 |
| 8 | Define frequency hopping. Explain frequency hopping in detail. | Understand | 5 |
| 9 | What are the Advantages of DS-SS systems? | Understand | 5 |
| 10 | What are the Disadvantages of DS-SS systems? | Remember | 8 |
| 11 | List the Advantages of FH-SS System | Remember | 1 |
| 12 | List the Disadvantages of FH-SS System | Remember | 2 |

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