TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2076 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

## *Subject:* - Communication System II *(EX 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. Define any three types of noises. Calculate coding efficiency of a six symbol source with probabilities P={0.36, 0.18, 0.12, 0.09, 0.07} using Shannon Fano and Huffman's coding techniques. [3+8]
2. State Nyquist sampling theorem. Explain natural sampling with its appropriate mathematical derivation. [3+6]
3. a) Twenty four voice signals are sampled uniformly and then have to be time division multiplexed. The highest frequency component for each voice signal is equal to 3.4 kHz. Now,
   (i) If the signals are pulse amplitude modulated using Nyquist rate of sampling, what would be the minimum channel bandwidth required.
   (ii) If the signal are pulse code modulated with an 8 bit encoder, what would be the sampling rate? The bit rate of the system is given as $1.5\times10^6$ bits/sec. [4+3]

   b) Explain the need for non uniform quantization. Determine the SQNR for delta modulation with no slope overload condition. [2+5]
4. State and derive the relation between entropy and information rate. Derive the expression which shows the limit of Shannon's channel capacity theorem when bandwidth tends to infinity. [4+6]
5. Explain the generation and non coherent detection for BFSK signal and also show the signal space diagram for a BFSK signal. [8]
6. Explain threshold effect in detection of FM signal. Derive the expression of error probability for coherent detection of Phase Shift Keying (PSK). [4+6]
7. The 1/3 rate convolutional encoder with constraint length equal to 3 has following three generator sequences each of length 3. [8]
   $\left(g_0^{(1)}, g_1^{(1)}, g_2^{(1)}\right)=(0,1,1)$
   $\left(g_0^{(2)}, g_1^{(2)}, g_2^{(2)}\right)=(1,0,1)$
   $\left(g_0^{(3)}, g_1^{(3)}, g_2^{(3)}\right)=(1,1,0)$
   Determine the encoded sequence for the following input message $(m_0,m_1,m_2,m_3,m_4)=(1\ 0\ 0\ 1\ 1)$
8. Write short notes on: [5×2]
   a) The eye diagram
   b) The E1 digital hierarchy

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TRIBHUVAN UNIVERSITY
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**Examination Control Division**
**2076 Ashwin**

| Exam. | Back | | |
|---|---|---|---|
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| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

## *Subject:* - Communication System II *(EX 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Compute coding efficiency of a source with symbols $\{A_0,A_1,A_2,A_3,A_4\}$ with corresponding probabilities {0.4,0.3,0.15,0.1,0.05} using (i) Binary coding (ii) Shannon-Fano Coding (iii) Binary Huffman Coding [2+2+2]
2. Define Sampling. Explain with proper illustration the Natural Sampling and Flat Top Sampling. Find the Nyquist rate and the interval for $m(t) = \sin^2(400\pi t)$ [6+4]
3. What is companding and why it is necessary? Explain any two types of companding techniques. [2+5]
4. Discuss with examples, the implications and limitations of Shannon Hartley Channel capacity theorem. [8]
5. Draw the timing diagram of Polar NRZ, Polar RZ, Manchester and unipolar Rz for the following binary sequence 10110000100000000111. [6]
6. What do you mean by Stochastic Process? Explain with necessary derivation passage of wide-sense random signals through a LTI. [2+10]
7. Derive the expression for evaluating error probability in binary baseband system and compare it with M-ary system. [8]
8. What do you mean by optimum detector? Find the impulse response of optimum detector in the presence of additive white noise. [2+6]
9. Define Hamming Weight and Hamming Distance. Construct a (7, 4) cyclic code using a generator polynomial $g(x) = x^3 + x^2 + 1$ with data vector 1011. [4+5]
10. An analog baseband signal, band limited to 100 Hz, is sampled at the Nyquist rate. The samples are quantized into four message symbols that occur independently with probabilities p1 = p4 = 0.125 and p2 = p3. Determine the information rate (bits/sec) of the message source signal. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2075 Chaitra**

| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

***Subject:*** - Communication System II *(EX 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Discuss the importance of source coding in Digital Communication system. A DMS emits one of the seven symbol with probabilities P = [0.25, 0.2, 0.15, 0.08, 0.07, 0.03, 0.02]. Find the coding efficiency, Code Redundancy for both Shannon-Fano coding and Fixed Length Coding and compare result. [4+6]
2. Define the Aliasing and Aperture effects in Sampling. Explain the types of sampling techniques with waveforms. [4+6]
3. a) What do you mean by companding? Briefly explain the operation of Differential PCM (DPCM) along with derivation and block diagram. [2+4]
   b) The bandwidth of a TV plus audio signal is 4.5 MHz. If this signal is converted to PCM with 1024 quantization levels, determine bit rate of the resulting PCM signal. Let us assume that the signal is sampled at a rate 20% above the Nyquist rate. [4]
4. What do you understand by Inter Symbol Interference (ISI)? Explain modified Duobinary coding technique and illustrate it using binary input sequence 10110011. [6+4]
5. Explain the Delta Modulation encoder and decoder with its derivations and diagram. Compare between PCM and DM? [6+1]
6. Explain and compare ideal and practical RC filtering of white noise with respect to change in autocorrelation function. [8]
7. Find the detection gain for SSB-SC demodulation and compare with DSB-SC. [8]
8. Define hamming distance and hamming weight. For a (6,3) code, the parity check matrix is given by $H = \begin{bmatrix} 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \end{bmatrix}$. Determine whether a received code vector 100101 is erroneous. [2+5]
9. Write short notes on: (Any two) [5×2]
   a) M-ary baseband data communication
   b) Threshold effect is WBFM
   c) Convolutional coder with example

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## *Subject:* - Communication System II *(EX702)*

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1. Six messages are transmitted with probabilities 0.3, 0.08, 0.1, 0.15, 0.25 and 0.12 respectively. Obtain their respective shannon-fano and Huffman's codes and code efficiencies. [8]
2. Illustrate and explain the ideal sampling and reconstruction of sampled signal. Find the Nyquist rate and the interval for ½ π Cos(400πt) Cos (1000πt). [6+4]
3. a) Differentiate between uniform quantization and non-uniform quantization. Why is non-uniform quantization done for speech signal? Explain about companding laws. [2+2+2]
   b) Explain why DPCM is preferred over PCM? Explain the working principle of DPCM with necessary transmitter and receiver. [2+4]
4. Briefly explain Shannon Hartley channel capacity theorem its implication and theoretical limits. Show that channel capacity (C) = 1.44 $S/N_0$, when the channel Band width tends to infinity. [6+4]
5. a) Explain the differences between T1 and E1 digital hierarchy. [4]
   b) With necessary derivations show that in case of PCM, SQNR increases approximately by 6dB for each extra bit used. [6]
6. Represent binary sequence 10110101 in Polar NRZ, unipolar RZ, AMI and Manchester codes. [6]
7. Explain the modulation and demodulation techniques used in QPSK. [8]
8. Derive expression for evaluating error probability of M-ary system. [8]
9. The generator polynomial of a (7,4) cyclic code is $G(p) = P^3+p+1$. Obtain the code vector for the code in non-systematic and systematic form with message vector 0101. [8]

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INSTITUTE OF ENGINEERING
# Examination Control Division
**2074 Ashwin**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

## *Subject:* - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Distinguish between the Source coding and Channel coding. A discrete memoryless source has an alphabet of five symbols $S_0$, $S_1$, $S_2$, $S_3$, $S_4$ with probabilities of 0.55, 0.15, 0.15, 0.1 and 0.05 respectively. Determine the Huffman code for each symbol and calculate high the coding efficiency. [3+2+2]
2. State Sampling theorem in terms of transmitter and receiver. Explain aliasing and aperture effect with remedy solutions. [4+6]
3. a) Derive expression for evaluating signal-to-quantization noise ratio (SQNR) for uniform quantization in terms of number of levels and number of bits per source symbol. [7]
   b) Describe E1 frame and its TDM hierarchy along with signaling rate. [3+3]
4. A continuous signal is band limited to 5 KHz. The signal is quantized in 6 levels of a PCM system with the probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}$ and $\frac{1}{32}$. Calculate the entropy and information rate. [5+5]
5. Explain intersymbol interference (ISI) in baseband digital communication system with derivations. Also explain the ideal and practical solutions of ISI. [4+3+3]
6. Derive the expression for the IR of a matched filter. [8]
7. a) Compute the figure of merit of non coherent FM System and explain the threshold effects. [6+2]
   b) Derive the expression of error probability for coherent detection of Amplitude Shift Keying (ASK). [6]
8. Define Hamming Weight and Hamming Distance. Construct a (7, 4) Cyclic Code using a generator polynomial $g(x) = x^3+x^2+1$ with data vector 1011. [2+6]

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**Examination Control Division**
**2074 Chaitra**

| Exam. | Regular | | |
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## *Subject*: - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. The source of information symbols {A0, A1, A2, A3 and A4} have corresponding probabilities {0.4, 0.3, 0.15, 0.1 and 0.05}. Encode the source symbols using Huffman encoder and Shannon-Fano encoder and compare their efficiency. [8]
2. Briefly explain the terms "sub-sampling theory" and "operture effect". [2+2]
3. Explain E1 hierarchy of TDM-PCM Telephony. A television signal having a bandwidth of 4.2 MHz is transmitted using binary PCM system. Given that the number of quantization level is 512. Determine: [4+6]
   i) Code word length
   ii) Transmission bandwidth
   iii) Bit rate
   iv) SQNR
4. What is ISI? State two solutions for zero ISI. Explain duo-binary encoding with the use of precoder. [2+6]
5. Draw the timing diagram of Polar NRZ, AMI and Manchester for the following binary sequence 1011000010000000001. [6]
6. What do you mean by optimum detector? Show that the impluse response of the matched filter is reverse delayed version of the input signal. Explain auto correlation function. [2+6+3]
7. What do you mean by Ergodic Stochastic Process? Explain with necessary derivaion passage of wide-sense random signals through a LTI. [2+10]
8. What is detecting gain? Prove that for 100% modulation of (DSB-AM), the detection gain is less than 1. [8]
9. Define Hamming distance and Hamming weight. Explain the operation a 1/3 convolutional encoder. [2+6]
10. Why is non uniform quantization required, explain any one algorithms for implementing non-uniform quantization. [5]

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INSTITUTE OF ENGINEERING
**Examination Control Division**
**2073 Shrawan**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

## *Subject:* - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain in brief the functional block diagram and the basic elements of a digital communication system. Explain Shannon-Fano coding, [5+3]
2. State and prove sampling theorem. Define aliasing effect and aperture effect. [5+3]
3. a) Explain working principle of PCM with necessary figures and equations. [5]
   b) A PCM system uses a uniform quantizer followed by a 7 bit binary encoder. The bit rate of the system is equal to $50*10^6$ bits/sec. [3]
      i) What is the maximum message signal bandwidth for which the system operates satisfactorily?
4. Explain the necessity of non-uniform quantization for speech signal. Derive the expression for signal to quantization noise ratio in delta modulation. [2+6]
5. a) Given the binary sequence 1011001010 represent it in Polar NRZ, Polar RZ, Manchester and AMI codes. [4]
   b) What do you understand by intersymbol interference? Explain Duobinary coding technique with precoder and illustrate it using binary input sequence 0010110. [2+5]
6. Prove that the impulse response of the matched filter is reverse delayed version of the input signal. [8]
7. Find the detection gain for SSB-SC demodulation and compare it with DSB-SC. [3+3]
8. Derive the expression for evaluation the gain parameter ($SNR_0/SNR_1$) of non-coherent FM detector. [8]
9. Derive the general expression for evaluating error probability for binary Ask system and extend it to M-ary. [8]
10. Define Hamming weight and Hamming distance with examples. Validate the code if received code vector code is [100011] given that $H = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$ [3+4]

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INSTITUTE OF ENGINEERING
**Examination Control Division**
**2073 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

## *Subject:* - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Discuss the importance of source coding in Digital Communication System. A discrete memory less source emits five symbols with probabilities P= {0.3,0.25,0.2,0.15,0.1}, find coding efficiency for both fixed and shannon- Fano coding and compare results. [6+4]
2. Define the Aperture and Aliasing effects? A signal $g(t) = 10\cos(20\pi t)\cos(200\pi t)$ is sampled at the rate of 250 samples per second, then (i) determine the spectrum of the resulting sampled signal, (ii) specify the cut-off frequency of the ideal reconstruction filter so as to recover g(t) from its sampled version, and (iii) determine the Nyquist rate for g(t). [7+3]
3. Differentiate between uniform and non-uniform quantization. The information in an analog waveform with maximum frequency 4KHz is to be transmitted over a 16 - level PCM system. [4+6]
   a) What would be the maximum number of bits per sample?
   b) What is the minimum sampling rate and bit rate?
4. a) Explain any one type of correlative coding technique with its impulse response and transfer function. Mention how can we minimize error in duo-binary coding. [6+2]
   b) Given the binary sequence 1101010011 represent in polar NRZ, polar RZ, Manchester and AMI codes. [4]
5. What are the design goals of digital modulation techniques? Explain coherent binary PSK modulation technique with its signal space diagram, modulator and demodulator. [2+8]
6. Explain noise equivalent bandwidth. Prove that the impulse response of matched filter is a time reversed delayed version of input signal $S_i(t)$. [10+2]
7. Calculate detection gains for DSB-FC, DSB-SC and SSB and Also compare them. [8]
8. Why convolution coder are better suited than block coder? Determine systematic and non-systematic code vector for a (7,4) cyclic hamming code for message vector {1010} with generator matrix $g(x) = 1+x+x^3$ [2+6]

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2072 Kartik**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

***Subject:*** - Communication system II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Write down the significant of variable length coding with relevant example. A fixed length source encoder generates six symbols with probabilities {0.2, 0.15, 0.25, 0.05, 0.3, 0.05} and encoded by unique code word. Find entropy and maximum code efficiency. [2+3]
2. Explain Sub-sampling theorem. A signal $x(t) = \text{sinc}(5\pi t)$ is sampled (using uniformly spaced impulses) at a rate of 10 Hz. [2+2+2+1]
   i) Sketch the sampled of signal (not to scale);
   ii) Sketch the spectrum of the sampled signal for the range $|f| < 30$ Hz;
   iii) Explain whether you can recover the signal x(t) from the sampled signal.
3. Explain basic process of Non-uniform quantization including companding technique of its realization. An audio signal of frequency 4 KHz and maximum dynamic range of ±2.4V is digitized by PCM system with its bit rate of 64 KHz. Calculate numbers of bits per sample, quantization noise power and $SQNR_{dB}$. Estimate the minimum bandwidth required for TDM of 10 such audio signals (assume no extra framing and synchronization bits). [3+3+2]
4. A Delta modulator is used to encode speech signal band-limited to 3KHz with sampling frequency 10 KHz. For maximum signal amplitude of $A_{max} = 1$, find: [2+3+1]
   i) Minimum step size to avoid slope overloading.
   ii) Assuming the speech signal to be sinusoidal, find Signal to quantization noise ratio
   iii) Determine the minimum transmission bandwidth.
5. What is ISI? State Nyquist pulse shaping criteria for zero ISI. Explain duo-binary encoding with example. [2+2+4]
6. Why DPSK is preferred than PSK? Explain the Modulator, Demodulator and Signal Space Diagram for DPSK system. [1+2+2+1]
7. Define Matched filter. Explain the approximation of the matched filter for a rectangular pulse using a single pole RC low pass filter with variable bandwidth. [2+6]
8. What do you mean by Random process? Explain white noise with it's PSDF and autocorrelation function. [2+4]
9. With necessary derivations, explain the threshold effect in envelope detector for DSB-FC modulation in analog communication system. [7]
10. Derive the expression of error probability for binary PAM signal. [5]
11. Explain Convolutional Coder with suitable example. [6]
12. Write short notes on: (any two) [2×4]
    i) Eye diagram and its significance in digital communication system
    ii) Line codes
    iii) Adaptive Delta Modulation

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1. If a source emits symbols $X_i$ = {A, B, C, D, E, F} in the BCD format with
   a) Probabilities $P(X_i)$ = {0.3, 0.1, 0.02, 0.15, 0.4, 0.03} at a rate $R_s$ =14.4 Kbaud, find the following: [5]
      i) Information rate
      ii) Coding efficiency both with BCD and Huffman coded signal
   b) Explain Huffman codes with examples. [4]
2. State Nyquist sampling theory. Determine the Nyquist rate and Nyquist interval for a continuous time signal x(t)=6cos50Πt+20sin300Πt-10cos100Πt is to be sampled and quantize using 512 levels. [2+5]
3. Explain E1 digital hierarchy as related to telephony system. Evaluate the expression of SQNR in uniformly quantized PCM system. [4+4]
4. Explain Shannon channel capacity theorem. Write down theoretical limitations of this theorem. [2+3]
5. a) Define Inter Symbol Interference (ISI) in baseband digital communication system. Explain the ideal and practical solution for zero ISI. [2+6]
   b) Represent binary sequence 1001001101 in polar, NRz, polar RZ, Manchester and AMI codes. [4]
6. What do you understand by optimum detection? Show that the impulse response of the optimum detector network is the time shifted replica of the incoming signal. [2+5]
7. Find the error probability in coherent ASK and PSK detections and show that ASK requires double the average signal power than PSK for same error probability. [4+3]
8. Explain the modulator, demodulator and signal space diagram for FSK Modulation. [6]
9. With necessary derivation, compare noise performance of DSB-Am, DSB-SC, SSB-SC. [8]
10. Define Hamming weight and Hamming distance for a code vector x = (0111000) and the parity check matrix H given below. Prove that, the given code is valid. [2+4]

$$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}_{3\times 7}$$

11. Write short notes on: (any two) [5]
    i) Noise Equivalent Bandwidth
    ii) M-ary baseband data communication
    iii) Eye Diagram

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INSTITUTE OF ENGINEERING
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**2071 Shawan**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
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***Subject:*** - Communication system II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Explain the importance of source coding in Digital Communication System. A discrete memory less source emits one of the eight symbols with probabilities P = {0.25, 0.20, 0.2, 0.15, 0.08, 0.07, 0.03, 0.02}. If the output symbols are encoded using Huffman code, find the Coding efficiency and output bit if the symbol rate of the source is 1000 symbols per second. [2+4+2]
2. State and explain Nyquist-Kotelnikov sampling theorem with time domain and frequency domain analysis. Define aliasing and aperature effect. [6+2]
3. A message signal $x(t) = 6\cos(5000\pi t)$ is quantized in 128 levels using Nyquist sampling rate: [2+3+2]
   a) Find SQNR of the PCM signal
   b) Find the sampling frrequency required when same signal uses delta modulation for same SQNR
   c) If the system uses DM using Nyquist sampling rate, find SQNR degradation in DM as compared to PCM.
4. What do you mean by companding? Explain T1 hievarchy of TDM-PCM telephony. [2+4]
5. What is ISI? State Nyquist pulse shaping criteria for zero | s |. Explain duo-binary encoding with example. [2+2+6]
6. What do you understand by differential coding? Explain differential phase shift keying modulation and détection with example and diagrams. [2+5]
7. Prove that the impulse response of the matched filter is a time reversed delayed version of the input signal $S_i(t)$. [6]
8. With necessary derivations, compare the noise performance of DSB-SC and SSB-SC modulations in analog communication system. [6]
9. Define random process? show that the output of LTI is WSSP if the input is also a WSSP. [2+6]
10. What is the importance of hamming distance and hamming weight in coding theory? Explain with example the syndrome decoding method in linear block coding. [2+5]
11. Derive the expression of error probability in case of M-ary system. Compare binary and M-ary scheme in terms of bandwidth efficiency and system complexity. [5+3]

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***Subject:*** - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Explain the importance of source coding in digital communication system. A discrete memory less source emits four symbols with probabilities P = {0.125, 0.125, 0.25, 0.5}. If the output symbols are encoded using Shannon Fano code, find the Coding efficiency and compare the coding efficiency with that of BCD code. [2+4+2]
2. State Nyquist sampling theory. Determine the Nyquist rate and Nyquist interval for a continuous time signal $x(t)=6\cos 50\Pi t+20\sin 300\Pi t-10\cos 100\Pi t$ is to be sampled and quantize using 512 levels. [2+5]
3. Explain E1 digital hierarchy as related to telephony system. Evaluate the expression of SQNR in uniformly quantized PCM system. [4+4]
4. Why is DPCM superior over PCM? Explain its working principle with necessary figures and equations. [2+5]
5. What is Shannon's channel capacity theorem? Write down theoretical limitations of this theorem. [1+3]
6. State Nyquist Criteria for zero ISI in both time and frequency domain. What are two major difficulties with duo binary encoding method and explain how can they be solved? [3+6]
7. Represent binary sequence 1001001101 in polar, NRz, polar RZ, Manchester and AMI codes. [4]
8. Define moment and central moment of continuous random variable. Show that first central moment is always zero. Determine the noise equivalent bandwidth of RC-LPF and that of ideal LPF of zero frequency response one. Also, find output noise power of this RC-LPF when input is white noise. [5+1]
9. What do you mean by optimum detector? Find the impulse response of optimum detector in the presence of additive white noise. [1+6]
10. Derive the expression for evaluating the gain parameter ($SNR_o/SNR_i$) of non-coherent FM detector. [8]
11. With necessary assumption, derive the expression for bit error probability for binary ASK system. [6]
12. Define Hamming weight and Hamming distance for a code vector x = (0111000) and the parity check matrix H given below. Prove that, the given code is valid. [2+4]

$$H=\begin{bmatrix}1&1&1&0&1&0&0\\1&1&0&1&0&1&1\\1&0&1&1&0&0&1\end{bmatrix}_{3\times 7}$$

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2070 Ashad**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

***Subject:*** - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What is source coding? Develop Huffman coding of a 5 symbol source with probabilities: $S_0 = 0.3$, $S_1 = 0.25$, $S_2 = 0.2$, $S_3 = 0.15$, $S_4 = 0.1$. And also calculate Coding efficiency. [1+3+1]
2. a) With mathematical derivation show that original band limited signal band limited signal can be reconstructed from its samples taken at Nyquist rate. [5]
   b) What is aliasing effect and how it can be minimized? [3]
3. a) Find the signal to quantization noise ratio in Uniform Quantization in term of no of bits per source sample. [8]
   b) Explain functional block diagram of the PCM system. Find the signaling rate of the $T_1$ system and draw its frame diagram. [3+3]
4. a) Define Information and Entropy. Calculate the upper limit of the channel capacity as the bandwidth of the channel B tends to infinity. [2+4]

   ***OR***

   State Nyquist pulse shaping criteria for Zero ISI. Discuss any one pulse shaping method of ISI reduction.

   b) A discrete source emits one of 6 possible symbols per 10μs in statistically independent manner. The symbol probabilities are ¼, ¼, ¼, 1/8, 1/16 and 1/16 respectively. Calculate symbol rate, entropy and information rate. [6]
5. a) What is DPSK and how it can be implemented? [4]
   b) What is modem? Discuss the modes of operation of modems. [4]
6. a) Define noise equivalent bandwidth. Find mean and AC function at the output when a WSSP signal is passed through the LTI system. [3+5]
   b) Realize the matched filter with relevant mathematical support. [4]
7. a) What is capture effect? Calculate the gain parameter in DSB-FC with envelop detection. [2+5]
   b) Compare AM and FM in terms of power efficiency, brand width efficiency and system complexity. Calculate the error probability of coherent ASK. [3+4]
8. a) Define Hamming Weight and Humming Distance. [2]
   b) What is binary Cyclic Code? Construct a (7,4) Cyclic Code using a generator polynomial $g(x) = x^3+x^2+1$ with data vector 1011. [1+4]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2070 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

## *Subject*: - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Elaborate importance of source encoder? Write algorithm for Huffman's coding. [2+3]
2. What are the practical factors to be considered while sampling? Explain. If two band limited signals $X_1[t]$ and $X_2[t]$ have bandwidths of $W_1$ and $W_2$ Hertz respectively, estimate the maximum sampling interval required for the signal given by $Y[t] = X_1[t]\, X_2[t]$. [6+2]
3. What are the signalling (bit) rate and bandwidth requirement for the T1 and E1 digital carrier systems? Explain briefly about Differential Pulse Code Modulation (DPCM) encoder. [3+4]
4. Define PMA, PWM and PPM with corresponding waveforms. A Television signal having a bandwidth of 4.8MHz is transmitted using binary PCM system. Given that the number of quantization levels is 512. Determine: [1.5+1+1.5+1.5+1.5]
   i) Code word length
   ii) Transmission bandwidth
   iii) Final bit rate
   iv) Output signal to quantization noise ratio
5. Derive the expression for evaluating signal to quantization noise ratio (SQNR) for Delta modulation. [6]
6. Represent binary sequence 1011001010 in Polar NRZ, Polar RZ, Manchester and AMI codes. [4]
7. Explain the Modulator, Demodulator and Signal Space Diagram for QPSK modulation with relevant derivations. [8]
8. Differentiate between message and information? A discrete source is emitting one of 5 possible symbols per 10 Microsec. The probabilities are $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}$ and $\frac{1}{16}$. Find (a) Symbol rate (b) Source entropy (c) Information rate [2+3]
9. Explain the approximation of the matched filter for a rectangular pulse using an Ideal low pass filter with variable bandwidth. [6]
10. Derive the expression for evaluating error probability in binary communication system? What is threshold effect in FM? How it can be minimized? [7+3]
11. The generator polynomial of a (7,4) cyclic code is $g(x) = 1+x+x^3$. Find the code for the message vector 1011 in a non-syste matic and systematic form. [6]
12. Write short notes on:
    a) Linear prediction theory/coding [6]
    b) White noise and its psdf [2]

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24 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

**Examination Control Division**

**2069 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEX | Pass Marks | 32 |
| Year / Part | IV / I | Time | 3 hrs. |

***Subject*** - Communication System II *(EX702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the advantages of Digital Communication System as compared to analog communication system? Elaborate the importance of Source and channel encoders in Digital communication system. [2+3]
2. What do you mean by aperture effect in Sampling? How can it be corrected? A band pass signal with the spectrum in the range of (80-115) KHz is to be digitized, Calculate minimum sampling frequency required for the signal. [5+3]
3. Explain the E1 digital hierarchy. A speech signal with maximum frequency of 4 KHz and maximum amplitude of ± 1.1 V is applied to a PCM system with its bit rate of 32 Kbps. Calculate the SQNR and number of bits per sample. [4+3]
4. What do you mean by companding. Why is it necessary? Explain different types of companding methods. [3+4]
5. A signal of bandwidth 4.5 KHz is sampled at the double rate given by Nyquist, the signal is quantized in 8 levels, the probability of occurrence of the level are 0.1, 0.15, 0.15, 0.05, 0.2, 0.05, 0.18, 0.12. Find the minimum no of bits per sample and information rate. [4]
6. What is ISI? Explain two practical methods of minimizing ISI. [2+6]
7. Explain FSK modulation with its modulator, demodulator and signal space diagrams. [8]
8. What do you mean by random process? Explain White noise with its PSDF and Auto correlation function. [4]
9. Derive the expression for error probability for binary PAM system and extend it to M-ary system. [6+2]
10. Explain the threshold effect in non coherent detection of FM signal. How can it be corrected? [4+3]
11. Derive the expression of error probability for coherent detection of Amplitude Shift Keying (ASK). [6]
12. Write notes on: [8]
    a) The eye diagram
    b) Syndrome calculation in linear systematic block code.

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