Max. Marks: 100

## PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

## NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the $\mathbf{Q} .1$ will be collected by the invigilator after 45 minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.
Q. $1 \quad$ Choose the correct or the best alternative in the following:
a. The probability of an event such as $\mathrm{P}\left(\mathrm{B}_{\mathrm{j}} / \mathrm{A}_{\mathrm{i}}\right)$ that is the intersection of events from sub experiments is called the
(A) Marginal Probability
(B) Joint Probability
(C) Conditional Probability
(D) None of these
b. In Digital Communication Systems performance measuring parameter is
(A) SNR
(B) PDF
(C) Effective Noise
(D) None of these
c. The maximum rate at which data can be transferred over the channel with an arbitrarily small probability of error is known as
(A) Throughput
(B) Channel Bandwidth
(C) Channel Capacity
(D) None of these
d. Calculate the capacity of a low pass channel with a usable bandwidth of 3000 Hz and $\mathrm{S} / \mathrm{N}=103$ at the channel output.
(A) $2000 \mathrm{bits} / \mathrm{sec}$
(B) $4000 \mathrm{bits} / \mathrm{sec}$
(C) $6000 \mathrm{bits} / \mathrm{sec}$
(D) $30000 \mathrm{bits} / \mathrm{sec}$
e. The signal to noise ratios at the input and output of a two port device is
(A) $\left(\frac{\mathrm{S}}{\mathrm{N}}\right)_{0}=\left(\frac{\mathrm{S}}{\mathrm{N}}\right)_{\mathrm{i}} \frac{1}{1+\frac{\mathrm{P}_{\mathrm{e}}}{\mathrm{P}_{1}}}$
(B) $\left(\frac{\mathrm{S}}{\mathrm{N}}\right)_{0}=\left(\frac{\mathrm{S}}{\mathrm{N}}\right)_{\mathrm{i}} \frac{1}{1+\frac{\mathrm{T}_{\mathrm{e}}}{\mathrm{T}_{1}}}$
(C) $\left(\frac{S}{N}\right)_{0}=\left(\frac{S}{N}\right)_{i} \frac{1}{1+\frac{g_{e}}{g_{1}}}$
(D) $\left(\frac{\mathrm{S}}{\mathrm{N}}\right)_{0}=\left(\frac{\mathrm{S}}{\mathrm{N}}\right)_{\mathrm{i}} /\left\{\frac{1}{1+\frac{\mathrm{T}_{\mathrm{e}}}{\mathrm{T}_{1}}}\right\}$


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f. By increasing the redundancy of the encoding we can make the probability of error approach to
(A) 0
(B) $\infty$
(C) $\log _{2} \mathrm{M}$
(D) None of these
g. It is possible to detect and correct errors by adding extra bits called
(A) Message Stream
(B) Check Bits
(C) Code Word
(D) None of these
h. The product of message block and generator matrix is called
(A) Code word
(B) Code rate
(C) Block length
(D) None of these
i. Number of check bits in a $(\mathrm{n}, \mathrm{k})$ block code are
(A) $q=n / k$
(B) $\mathrm{q}=\mathrm{n}+\mathrm{k}$
(C) $q=n-k$
(D) $q=k / n$
j. Burst type errors in a system can be corrected by
(A) Cyclic Codes
(B) Linear Block Codes
(C) Both (A) \& (B)
(D) None of these

## Answer any FIVE Questions out of EIGHT Questions. Each question carries 16 marks.

Q. 2 a. Draw and explain the block diagram of Model of a Noisy Communication System.
b. The input to an RC low-pass network is a zero mean stationary Gaussian random process $\mathrm{X}(\mathrm{t})$ with $\mathrm{R}_{\mathrm{xx}}(\tau)=\exp (-\alpha|\tau|)$. Find the mean variance, and psd of the output $\mathrm{Y}(\mathrm{t})$.
Q. 3 a. Explain Standard Deviation and Covariance in Statical Averages
b. Derive the expression for Chebhyshev's inequality for a random variable.
Q. 4 a. Draw and explain tree diagram for Markoff source having 3 states.
b. Explain Entropy and Information Rate of Markoff Sources.
Q. 5 a. Enlist the properties of Shannon's Encoding Algorithm which yields a source encoding procedure.
b. Explain Huffman Coding with an example.

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Q. 6 a. Show that (i) $\mathrm{H}(\mathrm{X} \mid \mathrm{Y})=\mathrm{H}(\mathrm{X})$ when X and Y are statistically independent, and (ii) $\mathrm{H}(\mathrm{X} \mid \mathrm{Y})=0$ when $\mathrm{X}=\mathrm{Y}$.
b. Give one Application of the Channel Coding Theorem to Binary Symmetric Channels.
Q. 7 a. A Gaussian channel has a bandwidth of 4 kHz and a two-sided noise power spectral density $\eta / 2$ of $10^{-4} \mathrm{watt} / \mathrm{Hz}$. The signal power at the receiver has to be maintained at a level less than or equal to $1 / 10$ of a milliwatt. Calculate the capacity of this channel.
b. Explain in detail Mutual Information for Continuous Ensembles.
Q. 8 a. Explain with block diagram Error Control coding by showing channel bit error probability and message bit error probability.
b. Design a linear block code with a minimum distance of three and a message block size of eight bits.
Q. 9 a. Discuss about the Algebraic Structure of Cyclic codes.
b. Explain Maximum Likelihood Decoding of Convolutional Codes.

