53 (EC-502) DGCM

2014

DIGITAL COMMUNICATION

Paper : EC 502

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **Q. no. (1)** and **any four** from the rest.*

1. *(a)* A fair dice is thrown twice. What is the probability that the summation is less than five ?

   (a) 1/6 (b) 5/36 (c) 5/16 (d) 0

   (b) The relation between PDF and CDF is

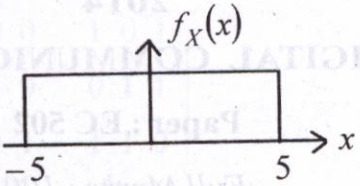
   (a) $f_X(x) > F_X(x)$

   (b) $F_X(x) = \int_{-\alpha}^{\alpha} f_X(x)$

   (c) $F_X(x) = \int_{-\alpha}^{x} f_X(x)\,dx$

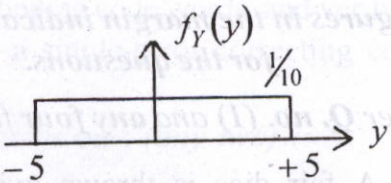
   (d) $F_X(x) = \frac{d}{dx} f_X(x)$

(c) A random variable has following probability density function

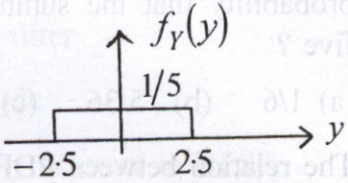


What is the pdf of $Y = 2X$?

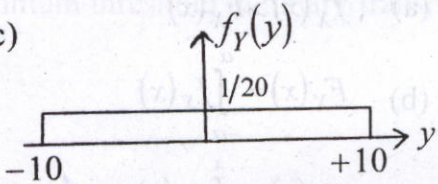
(a)



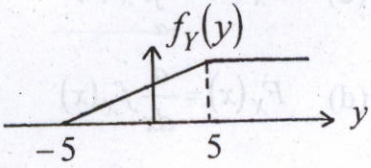
(b)



(c)



(d)



(d) Which statement is not true ?

(a) Samples of a gaussian noise is uncorrelated.

(b) If noise is filtered SNR increases.

(c) Noise is an undesired part in a signal and it can be eliminated completely by filtering.

(d) Samples of filtered noise air correlated.

(e) In a binary signal source $P(0) = P$, find the probability to get the following sequence

1 0 1 1 0 0 1

(a) $P^3(1-P)^4$

(b) $P^4(1-P)^3$

(c) $P(1-P)$

(d) ${}^7C_3\, P^3(1-P)^4$

(f) In a binary signal transmission technique 0 is represented by $-4V$ and 1 is represented by $6V$. What is the optimum threshold for detection ?

(a) $0V$ (b) $5V$ (c) $-5V$ (d) $1V$

(g) In a binary PSK system signal to noise ratio is $20dB$. What is the probability of error ?

(a) $\frac{1}{2}erfc\left(\sqrt{50}\right)$

(b) $\frac{1}{2}erfc(50)$

(c) $\frac{1}{2}erfc\left(\sqrt{200}\right)$

(d) $\frac{1}{2}erfc\left(\sqrt{100}\right)$

(h) Function of a matched filter is

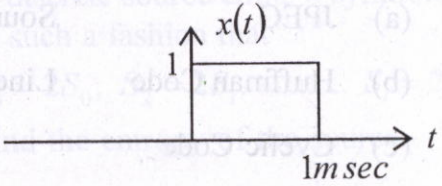
(a) To filter noise only

(b) To increase the signal power only

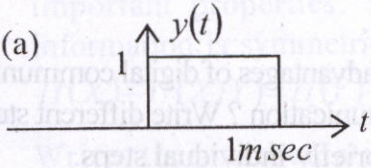
(c) To optimize SNR

(d) It is used to reduce reflection of the signal in transmission line.

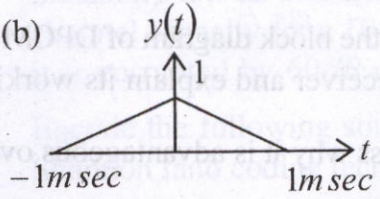
(i) The following signal is transmitted through a matched filter. What will be the output of matched filter ?



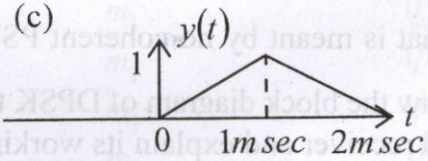
(a)



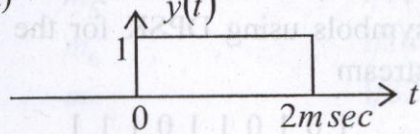
(b)



(c)



(d)



(j) Match the following :

Group -A	Group-B
(a) JPEG	Source Code
(b) Huffman Code	Line Code
(c) Cyclic Code	
(d) Convolutional Code	

10×2=20

2. What are the advantages of digital communication over analog communication ? Write different steps of PCM and discuss briefly individual steps. 5+15

3. (a) Draw the block diagram of DPCM transmitter and receiver and explain its working. 15

(b) Discuss why it is advantageous over ordinary PCM. 5

4. (a) What is meant by non-coherent PSK ? 5

(b) Draw the block diagram of DPSK transmitter and receiver and explain its working. 12

(c) Show the transmitted symbols and received symbols using DPSK for the following bit stream

1 0 1 0 1 1 0 1 1 1 3

5. *(a)* What is difference between information and entropy ? Define both the things. 4

(b) A discrete source emits 8 symbols S_0 to S_7 in such a fashion that

$S_1 = 2S_0$, $S_2 = 2S_1$, ... $S_i = 2.S_{i-1}$.

Find the entropy of the source. 6

(c) Define Mutual information and state it's important properties. Show that Mutual information is symmetric 4+6

$$H(X)-H(X/Y)=H(Y)-H(Y/X)$$

6. *(a)* Write the mathematical statement of Shannon's law for channel capacity. Calculate channel capacity for a $10MHz$ channel when it is corrupted by $60dB$ noise. 6

(b) Encode the following source symbols using Shannon fano coding techniques. 6

Message	**Probability**
m_1	1/2
m_2	1/8
m_3	1/8
m_4	1/16
m_5	1/16
m_6	1/16
m_7	1/32
m_8	1/32

(c) For a (6, 3) Linear Block Code, the generator matrix G is 8

$$G = \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{I_K} \underbrace{\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}}_{P}$$

for all eight possible data words, find the corresponding code words, and verify that this code is a single-error correcting code.

7. Write short notes on : ***(any two)*** 10×2

(a) Companding

(b) Matched filter

(c) Cyclic code

(d) Probability of error in BPSK

(e) Optimum threshold in binary transmission.
