

**Instructions to the Students:**

1. All the questions are compulsory.
2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in ( ) in front of the question.
3. Use of non-programmable scientific calculators is allowed.
4. Assume suitable data wherever necessary and mention it clearly.

**(Level/CO)      Marks**

**Q.1 Solve Any Two of the following.**

- A) For a bivariate probability distribution of (X,Y) given below, find  $P(X \leq 1)$ ,  $P(Y \leq 3)$ ,  $P(X \leq 1, Y \leq 3)$ ,  $P(X \leq 1/Y \leq 3)$ ,  $P(Y \leq 3/X \leq 1)$  and  $P(X+Y \leq 4)$ .

**1      6**

X \ Y	1	2	3	4	5	6
1	0	0	1/32	2/32	2/32	3/32
2	1/16	1/16	1/8	1/8	1/8	1/8
3	1/32	1/32	1/64	1/64	0	2/64

- B) If X and Y are independent random variables, then prove that

**1      6**

(a)  $\text{Var}(X+Y) = \text{Var}(X) + \text{Var}(Y)$

(b)  $\text{Var}(X-Y) = \text{Var}(X) + \text{Var}(Y)$

- C) Prove that autocorrelation is an even function and its value is maximum at zero lag.

**1      6**

**Q.2 Solve Any Two of the following.**

- A) Find the constant C so that the function

**1      6**

$$f(x) = \begin{cases} C(x-1) & \text{for } 1 < x < 4 \\ 0 & \text{otherwise} \end{cases}$$

is a density function. Also find  $P(2 < X < 3)$ .

- B) Write a note on power spectral density and prove its properties.

**1      6**

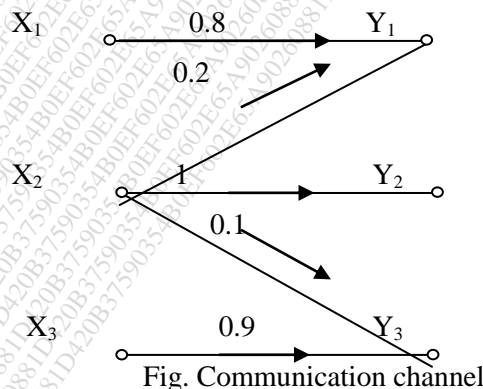
- C) Explain the Resistor noise with the help of an equivalent diagram and power density spectrum.

**1      6**

**Q.3 Solve Any Two of the following.**

- A) A discrete source is connected to the channel given in figure below. Calculate all entropies.  $P(Y) = [1/3 \ 1/3 \ 1/3]$

**2      6**



- B) Find the mutual information and channel capacity of the channel whose

**2      6**

$P(Y/X) = \begin{bmatrix} 0.8 & 0.2 \\ 0.3 & 0.7 \end{bmatrix}$  and  $p(x_1)=0.6$  and  $p(x_2)=0.4$ .

- C) For a standard voice band communication channel, the SNR is 30 dB and the transmission bandwidth is 3 kHz. What will be the channel capacity and the Shannon limit?

2 6

**Q.4 Solve Any Two of the following.**

- A) For a systematic linear block code, the three parity check digits are given by

3 6

$$C4 = d_1 + d_2 + d_3$$

$$C5 = d_1 + d_2$$

$$C6 = d_1 + d_3$$

- Construct generator matrix
- Construct code generated by this matrix
- Determine error correcting capability
- Prepare a suitable decoding table
- Decode the received code words 101100 and 000110

- B) A rate 1/2 convolution encoder has generating vectors as  $g_1 = (1, 1, 1)$ ,  $g_2 = (1, 0, 1)$ .

3 6

- Determine the dimension of the code
- sketch the encoder configuration
- Draw the code tree, state transition and trellis diagram
- If the input message is 1 0 0 1 1, determine the output sequence of the encoder.

- C) Write a note on Syndrome decoding. What happens if double error occurs in received code word when the minimum distance criterion is 3?

3 6

**Q. 5 Solve Any Two of the following.**

- A) Discuss any three types of vocoders in brief.

4 6

- B) Write a short note on sub-band coding.

4 6

- C) A parallel resonating circuit is tuned at 200 MHz with a Q of 10 and capacitance of 10 pF. The temperature of the circuit is 17° C. what noise voltage will be observed across the circuit by a wide band voltmeter? Assume the values of constant terms as usual.

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\*\*\* End \*\*\*