

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 $P(X+Y \leq 4)$.

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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

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- (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.

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Q.2 Solve Any Two of the following.

- A) Find the constant C so that the function
- $$f(x) = \begin{cases} C(x-1) & \text{for } 1 < x < 4 \\ 0 & \text{otherwise} \end{cases}$$

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

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

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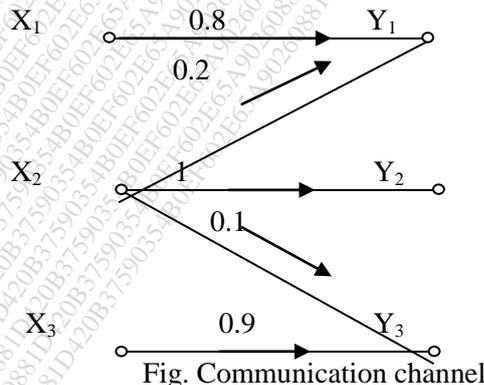
- C) Explain the Resistor noise with the help of an equivalent diagram and power density spectrum.

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Q.3 Solve Any Two of the following.

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

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

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$P(Y|X) = \begin{bmatrix} 0.8 & 0.2 \\ 0.3 & 0.7 \end{bmatrix}$ 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
- $$C4 = d_1 + d_2 + d_3$$
- $$C5 = d_1 + d_2$$
- $$C6 = d_1 + d_3$$
- i) Construct generator matrix
 ii) Construct code generated by this matrix
 iii) Determine error correcting capability
 iv) Prepare a suitable decoding table
 v) Decode the received code words 101100 and 000110
- B) A rate 1/2 convolution encoder has generating vectors as 3 6
- $$g_1 = (1, 1, 1), g_2 = (1, 0, 1).$$
- a. Determine the dimension of the code
 b. sketch the encoder configuration
 c. Draw the code tree, state transition and trellis diagram
 d. 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. 4 6

*** End ***