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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION – JULY 2024

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| **Semester : VI** | **Date : 4-7-2024** |
| **Course Code :ECE3012** | **Time :1:30 PM-4:30 PM** |
| **Course Name :Information Theory and Coding** | **Max Marks : 100** |
| **Program :B.Tech Electronics and Communication Engg** | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 4 QUESTIONS 4Q X 5M=20M** | | | |
| 1 | **Consider a source S= {s1,s2,s3} with P={1/2, ¼, ¼} Find self information of each message and entropy of the source** | (CO 1) | [Knowledge] |
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| 2 | **With a neat block diagram explain the information system** | (CO1) | [Knowledge] |
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| 3 | **Distinguish between Shannon and Shannon-Fano algorithm of coding** | (CO2) | [Knowledge] |
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| 4 | List and briefly explain different types of errors that occur in communication systems | (CO4) | [Knowledge] |
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| 5 | How will you convert a noise matrix into Joint Probability Matrix (JPM). Explain with an example. | (CO3) | [Knowledge] |
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| 6 | Fro the given JPM calculate H(X) and H(Y)  P(X,Y) = 0.05 0 0.2 0.05  0 0.1 0.1 0  0 0 0.2 0.1  0.05 0.05 0 0.1 | (CO3) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 7 | **An analog system is band limited to 500Hz and is sampled at Nyquist Rate. The samples are quantized into 4 levels. The quantization levels are assumed to be independent and occur with probabilities p1=p4=1/8, p2=p3=3/8. Find the information rate of the source.** | (CO1) | [Comprehension] |
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| 8 | **A black and white TV picture consists of 525 lines of picture information. Assume that each line consists of 525 picture elements (pixels) and that each element can have 256 brightness levels. Picture are repeated at the rate of 30 frames/sec. Calculate the average rate of information conveyed by a TV set to a viewer.** | (CO1) | [Comprehension] |
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| 9 | **Given the messages x1, x2, x3, x4, x5 and x6 with respective probabilities 0.4, 0.2, 0.2, 0.1, 0.07 and 0.03. construct a binary code using Shannon-fano encoding procedure. Calculate code efficiency and redundancy.** | (CO2) | [Comprehension] |
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| 10 | **Consider a source S={s1,s2} with probabilities ¾ and ¼ respectively. Obtain Shannon-Fano code for the source S and its second extension** | (Co2) | [Comprehension] |
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| 11 | Derive the equation for the capacity of a binary symmetric channel | (CO3) | [Comprehension] |
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| 12 | A source produces 5 symbols s1, s2, s3, s4 and s5 with respective probabilities of 0.1, 0.3, 0.4, 0.12 and 0.08. Construct Huffman binary code. | (CO3) | [Comprehension] |
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| 13 | For a systematic (6,3) linear block code, the parity matrix P is given by  [p] = 1 0 1  0 1 1  1 1 0 Find all the code vectors | (CO4) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 14 | **A source emits one of the four probable messages M1, M2, M3, M4 with probabilities of 7/16, 5/16, 1/8 and 1/8 respectively. Find the entropy of the source. List all the elements of second extension of the source. Hence show that H(S^2) = 2 H(S)** | (CO1) | [Application] |
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| 15 | Apply Huffman encoding procedure for the following message ensemble and find code efficiency and redundancy.  [S] = [s1, s2, s3, s4, s5, s6, s7, s8]  P[Si] = [ 0.36, 0.24, 0.12, 0.08, 0.08, 0.07, 0.03, 0.02] | (CO2) | [Application] |
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| 16 | A binary symmetric channel has the following noise matrix with source probabilities of P(x1) = 2/3 and p(x2) = 1/3  P(Y/X) = ¾ ¼  ¼ ¾ . Determine H(X), H(Y), H(X,Y), H(Y/X), H(X/Y) and I(X,Y). | (XXX) | [Application] |
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