IIIT-H
EC5.102: Information and Communication
Summer-2025

Exam: Quiz-2
Marks: 20

Date: 3-Apr-2025
Time: 11:45 am to 12:30 pm

Instructions:

- Answering all the questions is compulsory.
- All steps should be justified in detail.
- Clearly state the assumptions (*if any*) made that are not specified in the questions.

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1. (4+3=7 points) Answer the following questions on Huffman coding.
   (A) Construct a binary Huffman code for the following distribution on five symbols: $\mathbf{p} = (0.3, 0.3, 0.2, 0.1, 0.1)$. What is the average length and efficiency of this code?
   (B) Construct a probability distribution $\mathbf{p}'$ on five symbols for which the code that you constructed in part (A) has an average length (under $\mathbf{p}'$) equal to its entropy $H(\mathbf{p}')$.
2. (5 points) Give an example of a ternary source code with at least four codewords such that the code is uniquely decodable but not an instantaneous code. Justify your answer.
3. (4+4=8 points) Answer the following questions related to linear block codes.
   (A) For the codebook given below, write down a generator matrix with cyclic structure and a systematic generator matrix.
   (B) Is it a Hamming code of length 15? If yes justify. If not, write down a generator matrix of a Hamming code of length 15.

[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]	[0 0 0 0 1 0 1 0 0 1 1 0 1 1 1]
[0 0 0 1 0 1 0 0 1 1 0 1 1 1 0]	[0 0 0 1 1 1 1 0 1 0 1 1 0 0 1]
[0 0 1 0 0 0 1 1 1 1 0 1 0 1 1]	[0 0 1 0 1 0 0 1 1 0 1 1 1 0 0]
[0 0 1 1 0 1 1 1 0 0 0 0 1 0 1]	[0 0 1 1 1 1 0 1 0 1 1 0 0 1 0]
[0 1 0 0 0 1 1 1 1 0 1 0 1 1 0]	[0 1 0 0 1 1 0 1 1 1 1 0 0 0 1]
[0 1 0 1 0 0 1 1 0 1 1 1 0 0 0]	[0 1 0 1 1 0 0 1 0 0 0 1 1 1 1]
[0 1 1 0 0 1 0 0 0 1 1 1 1 0 1]	[0 1 1 0 1 1 1 1 0 0 0 0 1 0 1 0]
[0 1 1 1 0 0 0 0 1 0 1 0 0 1 1]	[0 1 1 1 1 0 1 0 1 1 0 0 1 0 0]
[1 0 0 0 0 1 0 1 0 0 1 1 0 1 1]	[1 0 0 0 1 1 1 1 0 1 0 1 1 0 0]
[1 0 0 1 0 0 0 1 1 1 1 0 1 0 1]	[1 0 0 1 1 0 1 1 1 0 0 0 0 1 0]
[1 0 1 0 0 1 1 0 1 1 1 1 0 0 0]	[1 0 1 0 1 1 0 0 1 0 0 0 1 1 1]
[1 0 1 1 0 0 1 0 0 0 1 1 1 1 0]	[1 0 1 1 1 0 0 0 0 1 0 1 0 0 1]
[1 1 0 0 0 0 1 0 1 0 0 1 1 0 1]	[1 1 0 0 1 0 0 0 1 1 1 1 0 1 0]
[1 1 0 1 0 1 1 0 0 1 0 0 0 1 1]	[1 1 0 1 1 1 0 0 0 0 1 0 1 0 0]
[1 1 1 0 0 0 0 1 0 1 0 0 1 1 0]	[1 1 1 0 1 0 1 1 0 0 1 0 0 0 1]
[1 1 1 1 0 1 0 1 1 0 0 1 0 0 0]	[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1]
