

Student ID

JK LakshmiPat University, Jaipur
Institute of Engineering and Technology

End Term Examination
B.Tech 2nd Year/ 5th semester 2013-14



Course Name: Information Theory and Coding

Max Marks: 40

Course Code: ECE521

Time: 03.00 hr

Instructions:

1. Attempt all sections.
2. All subparts of section A is of 1 Mark.
3. Attempt any Five Questions from Section B. Each Question in this section is of 4 Marks.
4. Use of Scientific Calculator is allowed.

Section A

(10 Marks)

Q.1

- a) For a linear (7,4) block code, find the ratio of parity bits to message bits and the code rate.
- b) Given $C_1 = 1\ 1\ 0\ 1\ 0\ 1\ 1$ and $C_2 = 1\ 0\ 1\ 1\ 1\ 0\ 1$, Find the difference in their Hamming weights and the Hamming weight of their difference.
- c) The code tree of an (n, k, L) linear convolutional code repeats after the stages.
- d) A fair dice is thrown and simultaneously a fair coin is also tossed. The die showed up 3 and the coin showed up 'head'. Find the information associated with these.
- e) Explain Hamming Distance.

Q.2

- a) Why do we use cyclic codes ?
- b) What is code efficiency?
- c) What is Kraft's inequality ?
- d) Why do we use source coding ?
- e) Why do we use channel coding ?

Section B

(20 Marks)

Q.3 Calculate the entropy in bits for each of the following random variables:

- a) Pixel values in an image whose possible grey values are all the integers from 0 to 255 with uniform probability. [1 mark]
- b) Humans grouped by whether they are, or are not, mammals. [1 mark]
- c) Gender in a tri-sexual insect population whose three genders occur with probabilities $1/4$, $1/4$, and $1/2$. [2 marks]

Q.4 How do you know that, on average, for samples drawn from this alphabet, your code uses the shortest possible code length per symbol? Demonstrate numerically that your code satisfies this optimality condition.

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Q.5 Construct an efficient, uniquely decodable binary code, having the prefix code and shortest possible average code length per symbol, for an alphabet whose five letters appears with these probabilities.

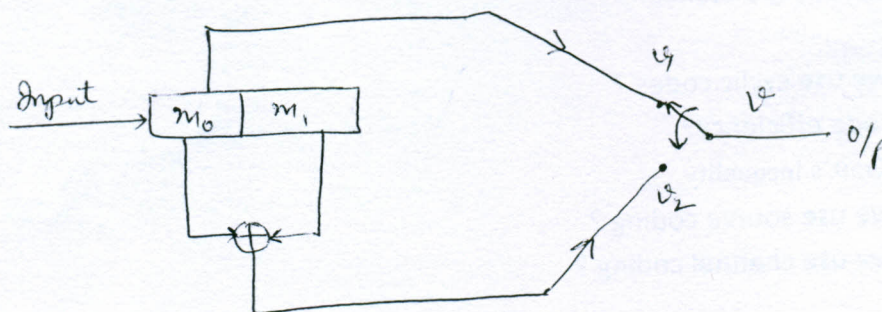
Letter	A	B	C	D	E
Probability	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$

Q.6 what is the maximum possible entropy H of an alphabet consisting of N different letters? In such a maximum entropy alphabet, what is the probability of its most likely letter? What is the probability of its least likely letter? Why fixed length codes inefficient for alphabets whose letters are not equiprobable.

Q.7

- Write the short note on BCH code.
- Write the short note on Reed- Soloman code.

Q.8 Sketch the state diagram and trellis diagram for the convolutional encoder shown below. Code rate is $\frac{1}{2}$ and constraint length $L=2$.



Section C

(10 Marks)

Q. 9 Consider an alphabet of 8 symbols whose probabilities are as follows:

A	B	C	D	E	F	G	H
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{128}$	$\frac{1}{128}$

- If someone has selected one of these symbols and you need to discover which symbol it is by asking "yes/no" questions that will be truthfully answered, what would be the most efficient sequence of such questions that you could ask in order to discover the selected symbol? [2.5 marks]
- By what principle can you claim that each of your proposed questions is maximally informative? [2.5 marks]
- On average, how many such questions will need to be asked before the selected symbol is discovered? [2.5 marks]
- What is the entropy of the above symbol set? [2.5 marks]