Q.1) Sketch the block diagram of a digital communication system. (1)

Q.2) Defined the messages from the point of view of information theory. (1)

اشرح معنى كلمة رسالة

Q.3) A discrete information source creates 4 symbols x_1 , x_2 , x_3 and x_4 , with probabilities of occurrence:

$$p(x_1) = 0.5$$
$$p(x_2) = 0.26$$
$$p(x_3) = 0.2$$
$$p(x_4) = 0.03$$

(a) What is the information content $I(x_i)$ of each symbol of the information source? (1)

الدلالة ومعنى

(b) Determine the entropy $H(X)$ of the information source. (1)

(c) Find number of binary decision (H_0) (1)

(d) What is the redundancy (R_s) of the information source? (1)

(e) Find a binary Shannon code. (1)

(f) Compute the average codeword length. $L \rightarrow 1.8$ (1)

(g) Sketch the binary tree of Shannon code. الرسم (1)

(h) Determine the redundancy of Shannon code. (1)

R_c

Notes

$2^{-1} = 0.5, 2^{-2} = 0.25, 2^{-3} = 0.125, 2^{-4} = 0.0625, 2^{-5} = 0.03125$, $2^{-6} = 0.015625$

| x_i	$p(x_i)$	$I(x_i)$	$L(x_i)$	P_i	code

Good Luck

College of Electronic and Technology / Beni Walid
Department of Communication Engineering

Mid Term Exam: November 2015   6th Semester
Subject: Information & Coding Theory   Examiner: Dr. Masoud Eddaghel
Date: 25 November 2015   Examination time: 90 Minutes

Q1/ [4 marks]
- (i)   Draw the Block diagram of Digital Communications.
- (ii)   Define the Information content $I(x)$.
- (iii)   What are the properties of the Information Content?
- (iv)   Define the number of binary decisions H_0
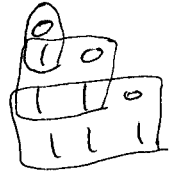
Q2/ [6 marks]
Four binary symbols : $x_1=0$, $x_2=10$, $x_3=110$, and $x_4=111$
- (i)   Decode the sequence of bits (01001011011111100)
- (ii)   Is the code is uniquely and instantaneously decodable? And why?
- (iii)   Represent the sequence of bits with a binary tree

Q3/ [2 marks]
A discrete information source creates 2 symbols x_1, and x_2 with probabilities of occurrence: $p(x_1)=0.3$, $p(x_2)=0.7$. Using Shannon coding
- (i)   Find the average code word length ($\overline{L}$).

Q4/ [5 marks]
- (i)   Write down three properties of linear block codes?
- (ii)   What is the code rate for uncoded transmission?
- (iii)   Is the parity check code systematic code?
- (iv)   How many errors can be corrected by single Parity check code?
- (v)   Single parity check code with information bits k=2. Find all possible code words.

Q5/ [8 marks]
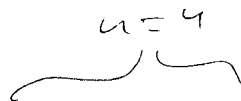Hamming Code with generator matrix G

$$G = \begin{pmatrix} 1000111 \\ 0100110 \\ 0010101 \\ 0001011 \end{pmatrix}$$

- (i)   Find the length of the cod words (n) and the length of information code words (k).
- (ii)   Are the code words systematic or non systematic?
- (iii)   Find the parity check codes for all possible code words.
- (iv)   Find minimum distance d_{min}.

Good luck
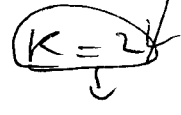
College of Electronic and Technology / Baniwalid
Department of Communication Engineering
6th Semester

Final Exam: 2015/2016
Subject: Information & Coding Theory
Date: 20th of January 2016

Examiner: Dr. Masoud Eddaghel
Examination time: 180 Minutes

Q.1/[6 marks]

a) Draw the block diagram of a digital communication system.

b) What are tasks of channel coding?

c) From point of view of information theory, what is the task of source coding?

Q.2/[6 marks]

a) Prove or disprove that the following codes are Huffman codes:

(i) $\{1, 01, 00\}$

(ii) $\{00, 01, 10, 110\}$

(iii) $\{01, 10\}$

Q3/ [6 marks]

a) Define the Noisy channel. → عرف

b) Define the Noiseless channel. → عرف

c) Draw the block diagram of information flow for Noisy (useless) channel.

ارسم

Q.4/[14 marks] A binary linear block code has the following pqrity check matrix :

P

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

$n = 7$

$k = 4$

a) Find the generator matrix G. →

b) Find the code rate R_c.

c) Find the minimum Hamming distance of the code d_{min}

d) Find the parity check matrix H.

e) Write down the parity check equations.

f) Write down the syndrome table for the assignment of error positions.

g) Find the psition of error by apply syndrome decoding to the received vector $y = (1\ 1\ 0\ 1\ 0\ 0\ 1)$

H^T

$1 = 1 + 1 + 1$
$0 = 1 + 1$
$1 = r + r + 1$

$S = y\ H^T$

$G = I\ P$

P^T

$H = P^T . I_{n-k}$

Final Exam: 2015/2016   6th **Semester**

Subject: Information & Coding Theory   **Examiner: Dr. Masoud Eddaghel**

Date: 20th of January 2016   **Examination time: 180 Minutes**

Q.5/[8 marks] A binary linear cyclic code $C(n, k)$ has code length $n = 7$ and generator polynomial: $g(x) = 1 + x^2 + x^3 + x^4$

a) The generator matrix G

b) The code rate Rc.

$K = 3$

$Rc = \frac{K}{n}$

c) Hamming distance $d_{min.} = 4$

d) If all the information symbols are '1's, what is the corresponding code vector?

$C(x) = 11\ 00\ 101$

Q.6/[10 marks] Given is a convolutional code with the following encoding circuit
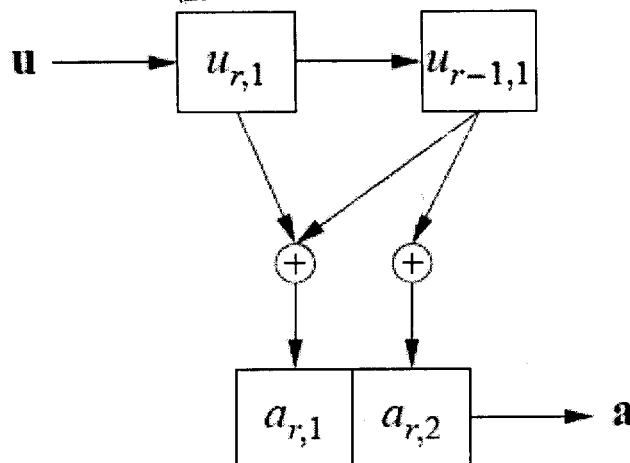
a) Find the parameter set (n, k, m) and the code rate $R\,c$ of the code.

b) Determine the state table which shows input, actual, output and next states.

c) Sketch the state diagram.

d) Sketch the Trellis diagram till the length of 5.

e) Is the code systematic or non-systematic?

Good Luck

Q1

Sources → Sources encoder → channel encoder → Modulator

Transmission channel ← § Nois §

Discret channel
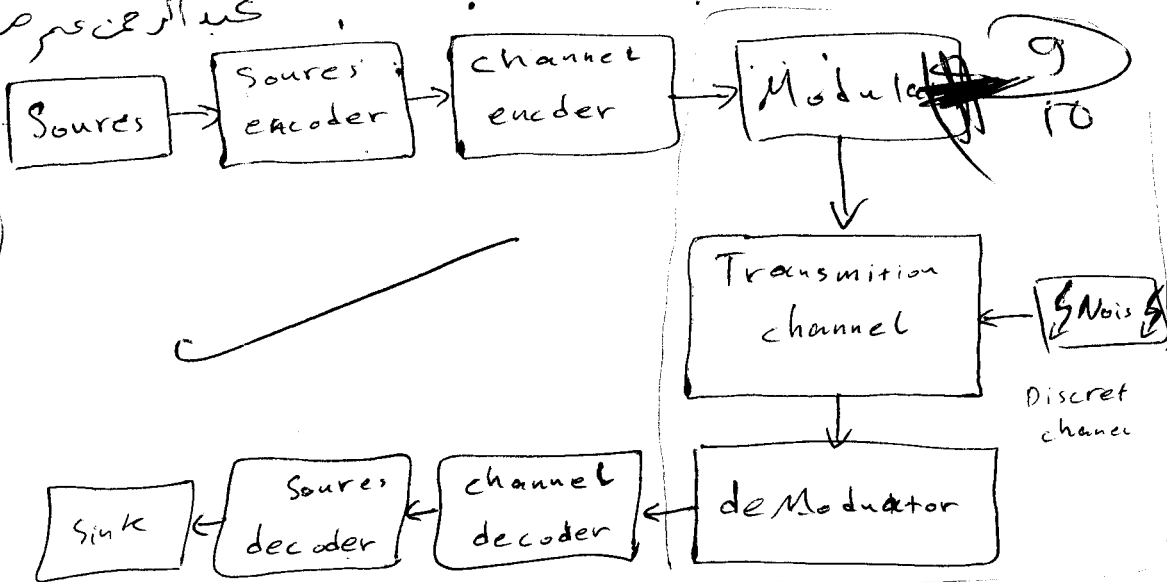
deModulator → channel decoder → Sources decoder → Sink

Q3

a) $p(x_1) = 0.5$ $I(x_1) = \log_2\left(\frac{1}{p(x_1)}\right) = \log_2\left(\frac{1}{0.5}\right) = 1$

$p(x_2) = 0.26$ $I(x_2) = \log_2\left(\frac{1}{0.26}\right) = 1.94$

$p(x_3) = 0.2$ $I(x_3) = \log_2\left(\frac{1}{0.2}\right) = 2.32$

$p(x_4) = 0.03$ $I(x_4) = \log_2\left(\frac{1}{0.03}\right) = 5.05$

b) $H(x) = \sum_{i=1}^{N} p(x_i) \cdot I(x_i) = [(0.5 * 1) + (0.26 * 1.94) + (0.2 * 2.32) + (0.03 * 5.05)]$

b) $H(x) = 1.6199$ bit/sample

c) $H_0 = \log_2(N) = \log_2(4) = 2$ bit

d) $R_S = H_0 - Hx = 2 - 1.6199 = 0.3801$ bit/sample

Q3 & 6

g

x_1

x_2

x_3

x_4

Q3 ⓔ

i	P(xi)	I(xi)	L(xi)	Pi	Code
1	0.5	1	1	0.00	0
2	0.26	1.94	2	0.5	1 0
3	0.2	2.32	3	0.76	1 1 0
4	0.03	5.06	6	0.96	1 1 1 1 0 0

2^{-1}		2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-6}
0.5		0.25	0.125	0.0625	0.03125		0.01
1		0	0				
1		1	0				
1		1	1	1		0	0

Q3 ⓕ

① $$ L = \sum_{i=1}^{n} p(xi) \cdot L(xi) = (0.5) + (0.26 * 2) + (0.2 * 3) + (0.03 * 6) = 1.9 $$

Q3 ⓗ

$Rs = Ho - H(x) = 0$

$Ho = \log_2(N) = 2 \, bit$

~~$Rs = 2 - 1.6199$~~

~~$H x = 1.6199$~~

$Rc = \bar{L} - H(x)$

$Rc = 1.8 - 1.6199 = 0.1801$ ①

Q3 ⓖ

موضوع أثر