Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 1

Even Semester: 2018-19 | **Date**: 05 March 2019

Course Code: ECE 216 | **Time**: 1 Hour

Course Name: Information Theory and Coding | **Max Marks**: 40

Programme & Sem: B.Tech, & VIII Sem (Group-I) | **Weightage**: 20%

Instructions:

(i) ***Scientific calculators are allowed.***

Part A

Answer **all** the Questions. **Each** question carries **six** marks. (2Qx6M=12)

1. Find the average information rate per message if the message m1, m2, m3 and m4 are transmitted with the probabilities p1=1/8,p2=2/8 p3=3/8 p4=2/8.
2. Find the output probabilities of a binary symmetric channel whose channel diagram is shown in the below figure 1, for p=0.2.

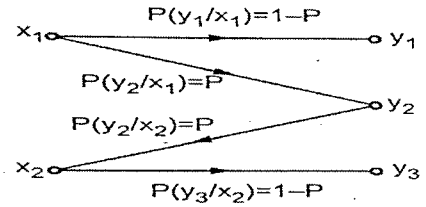

Fig.1

Part B

Answer the Question. Question carries **twelve** marks. (1Qx12M=12)

3. Prove that H(X, Y) =H(Y/X) +H(X).

Part C

Answer the Question. Question carries **sixteen** marks. (1Qx16M=16)

4. The graph of the Markoff source is shown in the below fig.2
   a. Calculate entropy of the source
   b. Draw Tree diagram
   c. Calculate probability of length ONE and probability of symbol sequence "CB".

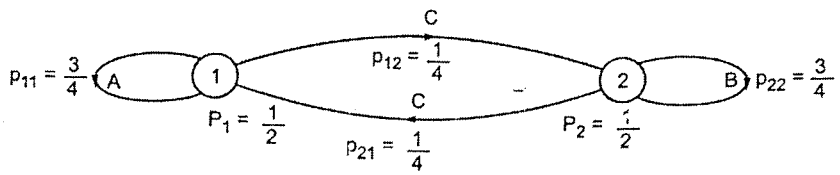

fig.2

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TEST - 2

Even Semester: 2018-19 | **Date**: 15 April 2019

Course Code: ECE 216 | **Time**: 1 Hour

Course Name: Information Theory and Coding | **Max Marks**: 40

Program & Sem: B.Tech & VIII Sem (Group-I) | **Weightage**: 20%

Instructions:

(i) ***Scientific calculators are allowed.***

Part A

Answer **both** the Questions. (4M+8M=12M)

1. Prove that $G.H^T=0$ where G-Generator matrix and H is parity check Matrix.
2. A Memory less source emits six messages with probabilities {0.4, 0.19, 0.16, 0.15, and 0.15}. Find the Shannon -Fano code and determine its efficiency.

Part B

Answer the Question. The Question carries **twelve** marks. (1Qx12M=12M)

3. A DMS with seven possible symbols $x_i, i = 1, 2, \ldots, 7$ and the corresponding probabilities p1 = 0.46, P2 = 0.30,p3 = 0.12, p4 = 0.06, p5 = 0.03, p6 = 0.02, and p7 = 0.01. Construct the Huffman code tree and find the coding efficiency.

Part C

Answer the Question. The Question carries **sixteen** marks. (1Qx16M=16M)

4. Write short notes on error detection with re transmission, the parity check matrix for a (6, 3) block code is given below find all valid code vectors and Generator Matrix.

$$H = \begin{bmatrix} 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

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END TERM FINAL EXAMINATION

Even Semester: 2018-19 | **Date**: 21 May 2019

Course Code: ECE 216 | **Time**: 3 Hours

Course Name: Information Theory and Coding | **Max Marks**: 80

Program & Sem: B.Tech & VIII Sem (Group-I) | **Weightage**: 40%

Instructions:

(i) Scientific calculators are allowed.

Part A

Answer **all** the Questions. **Each** question carries **one** mark. (20Qx1M=20M)

1.

i. Channel capacity is exactly equal to –
(a) bandwidth of demand
(b) Amount of information per second
(c) Noise rate in the demand
(d) None of the above

ii. The capacity of a channel is :
(a) Number of digits used in coding
(b) Volume of information it can take
(c) Maximum rate of information transmission
(d) Bandwidth required for information

iii. Entropy is basically a measure of:
(a) Rate of information
(b) Average of information
(c) Probability of information
(d) Disorder of information

iv. The Hartley-Shannon theorem sets a limit on the :
(a) highest frequency that may be sent over a given channel
(b) maximum capacity of a channel with a given noise level
(c) maximum number of coding levels in a channel with a given noise level
(d) maximum number of quantizing levels in a channel of a given bandwidth

v. The maximum value of entropy is :
(a) 1 (b) 2 (c) 3 (d) 4

vi. The probability density function of a Markov process is
(a) p(x1,x2,x3.....xn) = p(x1)p(x2/x1)p(x3/x2).....p(xn/xn-1)
(b) p(x1,x2,x3.....xn) = p(x1)p(x1/x2)p(x2/x3).....p(xn-1/xn)
(c) p(x1,x2,x3.....xn) = p(x1)p(x2)p(x3).....p(xn)
(d) p(x1,x2,x3.....xn) = p(x1)p(x2 * x1)p(x3 * x2).....p(xn * xn-1)

vii. The capacity of Gaussian channel is
(a) C = 2B(1+S/N) bits/s (b) C = B^2(1+S/N) bits/s
(c) C = B(1+S/N) bits/s (d) C = B(1+S/N)2 bits/s

viii. For M equally likely messages, the average amount of information H is
(a) H = $\log_{10}M$ (b) H = $\log_2M$
(c) H = $\log_{10}M^2$ (d) H = $2\log_{10}M$

ix. The negative statement for Shannon's theorem states that
(a) If R > C, the error probability increases towards Unity
(b) If R < C, the error probability is very small
(c) Both a & b
(d) None of the above

x. Code rate r, k information bits and n as total bits, is defined as
(a) r = k/n (b) k = n/r (c) r = k * n (d) n = r * k

xi. The information rate R for given average information H= 2.0 for analog signal band limited to B Hz is
(a) 8 B bits/sec (b) 4 B bits/sec (c) 2 B bits/sec (d) 16 B bits/sec

xii. Information rate is defined as
(a) Information per unit time
(b) Average number of bits of information per second
(c) rH
(d) d. All of the above

xiii. The mutual information
(a) Is symmetric (b) Always non negative
(c) Both a and b are correct (d) None of the above

xiv. The relation between entropy and mutual information is
(a) I(X;Y) = H(X) - H(X/Y) (b) I(X;Y) = H(X/Y) - H(Y/X)
(c) I(X;Y) = H(X) - H(Y) (d) I(X;Y) = H(Y) - H(X)

xv. The memory less source refers to
(a) No previous information
(b) No message storage
(c) Emitted message is independent of previous message
(d) None of the above

xvi. The information I contained in a message with probability of occurrence is given by (k is constant)
(a) I = k $\log_2$1/P (b) I = k $\log_2$P (c) I = k $\log_2$1/2P (d) I = k $\log_2$1/P^2

xvii. The expected information contained in a message is called
(a) Entropy (b) Efficiency (c) Coded signal (d) None of the above

xviii. If the errors are corrected at _____end/s, it is known as 'Forward Error Correction' (FEC).
(a) Transmitter (b) Receiver (c) Both a and b (d) None of the above

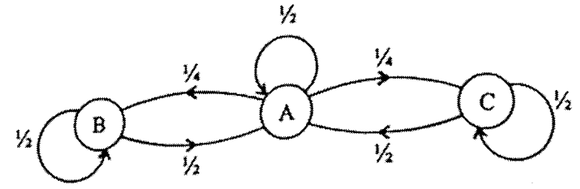
xix. Which among the below stated logical circuits are present in encoder and decoder used for the implementation of cyclic codes?
A. Shift Registers B. Modulo-2 Adders C. Counters D. Multiplexers
(a) A & B (b) C & D (c) A & C (d) B & D

xx. For a (6,4) block code where n = 6, k = 4 and d_{min} = 3, how many errors can be corrected by this code?
(a) 0 (b) 1 (c) 2 (d) 3

Part B

Answer **all** the Questions. **Each** question carries **ten** marks. (3Qx10M=30M)

2. For the first order markov source with a source alphabets S={A,B,C} shown in the figure, compute the probabilities of the states and find Entropy of the source.



3. A source produces eight messages s1,s2,…….,s8 with respective probabilities of 0.5,0.125,0.125,0.0625, 0.0625, 0.0625,0.03125 and 0.03125.Obtain Shannon-Fano binary code and find efficiency and redundancy.
4. For the given channel matrix compute the mutual information I(X,Y) with $p(x_1)$=0.6 and $p(x_2)$=0.4 P(Y/X)=[0.8 0.2:0.3 0.7]

Part C

Answer **both** the Questions. **Each** question carries **fifteen** marks. (2Qx15M=30M)

5. The generator polynomial for a (15,7) cyclic code is g(p)=1+p^4+p^6+p^7+p^8,find the code vector in systematic form for the message M(p)=p+p^2+p^3.Assume that the first and last bit of the code vector V(p) for M(p)=p+p^2+p^3 suffer transmission errors ,find the syndromes of V(p).
6. A rate 1/3 convolutional encoder has generating vectors (1 0 0),(1 1 1) and (1 0 1)
   a) Sketch encoder configuration
   b) If the input message sequence is (1 0 1 1 0), determine the output sequence of the encoder.
   c) Write the parameters of B C H codes.