APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Scheme for Valuation/Answer Key

Scheme of evaluation (marks in brackets) and answers of problems/key

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC401

Course Name: INFORMATION THEORY & CODING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) $H(S) = \sum_{i=1}^{n} p_i log \frac{1}{p_i}$ (1) (3)

H(S) = 1.96 bits/symbol (2)

(*Out of 2 mark; 1.5 marks for answer and 0.5 mark for unit of entropy*)

b) Marginal (1+1), conditional(3+3) and joint entropy(2) I(X,Y)(1 mark). and verifying their relation(1) (12)

(*This is a time consuming problem. Depending on the amount of calculations done maximum marks can be awarded*)

2 a) Channel Coding theorem: Positive statement (3), Negative statement (2) (5)

b) Shannon –Fano Code (2.5); Huffman code (2.5); Efficiency for Shannon-Fano code (2); Efficiency for Huffman code (2); Redundancy for Shannon-Fano code (0.5); Redundancy for Huffman code (0.5). (10)

H(S) = 2.2893 bit/symbol

Average length (Ĺ)= 2.4074 bit/symbol (Huffman code)

$\eta = \frac{H(S)}{Ĺ}$ = 95.098% (Huffman code)

Redundancy, γ = 1- η = 1-0.95098=0.049 ie 4.9% (Huffman code)

(*Shannon-Fano code and Huffmann code need not be unique*)

3 a) symmetric channel(2); Capacity(3) (5)

b) Binary Symmetric Channel (1) and Binary Erasure Channel (1); channel diagrams (1+1). (10)

Capacity of BSC, C = 1 - H(p) (2);

Capacity of BEC, C = 1 - α where α is the probability for erasure (4)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Generator Matrix, G = $\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$ or $\begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$(1) (7)

G=[PI] or G=[IP]
Code Vectors (2)

Standard array (4 marks)

(*Code vector may depends on the format of G*)

b) Shannon-Hartley theorem statement(1) (8)

Proof (5)

Implications (2 marks)

5 a) Capacity of Infinite Bandwidth channel (Derivation) (7) (7)

$C\infty=1.44\,\frac{S}{N_0}$

b) (a) C=33.88kbps (4) (8)

(b) $(\frac{S}{N_0})_{min}=1.66$ (4)

6 a) Ring and field : Definitions (1+1), Properties (1.5+1.5) (5)

b) i) Find generator and parity check matrices (1+1) (10)

ii) Draw the encoder circuit. (2)

iii) Sketch the syndrome calculation circuit (2)

iv) Illustrate the decoding of the received vector corresponding to the message vector 1001, if it is received with 5th bit in error.(4)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Convolutional encoder diagram (2) (8)

Find the output of the convolutional encoder for input sequence 11011 using transform domain approach(6)

$X^{(1)}(D)=(1+D^2+D^3)(1+D+D^3+D^4)$

$X^{(2)}(D)=(1+D+D^2+D^3)(1+D+D^3+D^4)$

$X^{(1)}=11110101$; $X^{(2)}=10011001$

X=1110101101100011

b) Convolutional encoder (7) (7)

c) Hamming Code Properties (5) (5)

8 a) Convolution encoder (3) (15)

State Transition Table (4)

State diagram (4)

Trellis diagram (4).

b) Syndrome decoding of cyclic code.(2) (5)

Syndrome decoder diagram (3)

9	a)	convolutional encoder (2) code tree(3) trace output(3)	(8)
	b)	Generation of Hamming codes. (7)	(7)
	c)	minimum free distance of a convolutional code (5)	(5)

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