

## SCHOOL OF ELECTRONICS ENGINEERING (SENSE)

BECE313L: Information Theory and Coding

## PROBLEM SHEET-2 Probability Based Source Coding

## **Instructions:**

1. Total Marks: 15

2. Weightage of marks in grades: 4%

3. Last Date for Submission: 16.09.2024

4. All answers must be handwritten

5. Late submission are not allowed

6. Submission must be through teams

Address each problem with thorough analysis and detailed solutions.

Q.No	Question					Marl				
1	Determine, which of the following codes shown in the table below are prefix									
	codes. Also draw the decision diagram for the prefix codes									
	Code A	Code B	Code C	Code D						
	00	11	01	101						
	10	101	001	1101						
	110	011	000	1010						
	0110	110	100	1100						
	010	1110	110	1111						
2		ode length		-	odes can be constructed for the $(2,3,4,5)$ for the corresponding	1				
3		ng coding s	•	cted in tabl	e has been used to encode the	1				

Source Symbols	$\mathbf{Code}\ \mathbf{A}$	Code B
T	00000	-
S	00001	0000
I	0001	001
Н	01	01
A	1	1

If the receiver receives the following bitstream:

Decode the information.

	An informa	ation sc	ource p	oroduces	a sec	quence	of in	depen	den	t syn	nbols h	naving	1
	following probabilities. Construct the binary and ternary code using Huffman												
	encoding Procedure and find its efficiency.												
			A	ВС		D	E	F	G				
		1	/4 1	/16 1/	8 1,	/16 1	./8	1/8	1/4	:			
5	An informa	ation so	urce p	roduces	a sec	quence	of in	depen	den	t syn	nbols h	naving	1
	following probabilities. Construct the quarternary Huffman code and find its												
	efficiency.												
		A	В	C	D	Е	F	C	1	Η			
		0.22	0.20	0.18	0.15	0.10	0.08	0.0	)5	0.02			
6	Consider a	discrete	e mem	oryless s	ource	with $S$	= (X	X, Y, Z	) wi	th st	ate pro	babil-	2
	ities $P = (0.7, 0.15, 0.15)$ for its output.												
	. A 1-	. IIa		- 1: 1	4 1	4 - C.	1 .1	1_		1	1. :	T2:1	
	• Apply Huffman encoding algorithm to find the codewords in binary. Find												
	the source efficiency and redundancy												
	• Consider the second-order extension of the source. Compute the code-										code-		
	words for this extended source and also find its efficiency												
7	Find the codewords and determine the average codeword length while encoding											oding	1
	the following sentence using Huffman coding Hope fuels dreams, urging us												
	the following	ig sente	1100 010.	0	iiaii co	oding <b>I</b>	dope	tuels	ar	cam	, urgi	ng us	
	the following onward, e	_		_		_						_	
		ven w	hen sl	nadows	lengt	hen, d	loub					_	
8	onward, e	ven w vithin	hen sl strug	nadows gles, str	lengt engtl	hen, d h blos	doub soms	ts ari	se.	Beli	eve, p	erse-	1
8	onward, e vere, for v	ven wi vithin ne follow	hen sl strug ving sc	nadows gles, strource $S =$	$\mathbf{engt}$ $\mathbf{engt}$ $\mathbf{e}$	hen, o	$\begin{array}{l} \textbf{doub} \\ \textbf{soms} \\ 0, E, F \end{array}$	ts ari	se.	<b>Beli</b>	eve, p	oerse-	1
8	onward, e vere, for v Consider th	ven which within the follows: 10, 0.15	trug strug ving so 5.0.25,	nadows gles, strource $S = 0.35, 0.08$	lengt engt $\{A, A\}$ $\{A, B\}$	then, on blosh $B, C, D$ $\{ \} $ . Fin	doubte soms $0, E, F$ d the	ts ari	se. h fo	<b>Beli</b> llowi	eve, p	oerse-	1
8	onward, e vere, for v  Consider th ties $P = \{0$	ven which within the following states of the	hen sl strug ving sc 5.0.25, Octerm	nadows gles, structure $S = 0.35, 0.08$ ine the $C$	lengt $=\{A,A,B,0.07\}$	hen, $C$ h blos $B, C, D$ $C$ h Fin g Efficient	doubtesoms $0, E, F$ doubtes the ency $a$	ts ari '} wit code and R	se.  h fo  word  edu:	Beli llowi ds usi ndan	eve, p  ng prol  ng Sha	oabili- nnon-	
	onward, e vere, for v  Consider the ties $P = \{0\}$ Fano Algor	ven when within the followithm, I be adic	strug ving sc 5.0.25, Determ	nadows gles, structure $S = 0.35, 0.08$ into the Obution of	lengt engtle $\{A, A, B, 0.07\}$ Coding	hen, $C$ h blos $B, C, D$ $C$ f Fin g Efficience sym	soms $0, E, F$ d the ency a	ts ari  '} with code and R A,B,C	h fo word edu	Beli llowi ds usi ndan- with	eve, p  ng prol  ng Sha  cy  probab	pabili- nnon- pilities	
9	onward, e vere, for v  Consider the ties $P = \{0\}$ Fano Algor  Consider a	ven which within the follows: 10, 0.15 ithm, Dadic Dadic Const	strug ving so 5.0.25, Determ distribut truct t	nadows gles, structure $S = 0.35, 0.06$ into the Coution of the codev	lengt engtle $\{A, A, B, 0.07\}$ Coding f sour	h blos B, C, L } . Fin g Efficience sym- usign S	soms  O, E, F  d the ency a  bols  Shann	ts ari  (code and R  (A,B,C)  (on-Fa	h fo word edu	Beli llowi ds usi ndan- with	eve, p  ng prol  ng Sha  cy  probab	pabili- nnon- pilities	1
	onward, e vere, for v  Consider the ties $P = \{0\}$ Fano Algorithm Consider a $\frac{1}{2^2}, \frac{1}{2}, \frac{1}{2^3}, \frac{1}{2^3}$	ven what within the following	strug ving sc 5.0.25, Determ distributed to the Co	nadows gles, structure $S = 0.35, 0.08$ into the Coution of the codeving Efficients	engtle en	h blos B, C, L }. Fin g Efficience sym- usign S v and I	soms 0, E, E d the ency a bols Shann Redun	ts ari  T} wit  Code  and R  A,B,C  on-Fa  dancy	h fo word edu C,D no-I	Beli llowinds usindand with	eve, p  ng prol  ng Sha  cy  probab  Coding	perse- pabili- nnon- pilities	1
9	onward, e vere, for vere, for vere, for vere, for vere, for vere consider the ties $P = \{0\}$ Fano Algor Consider a $\frac{1}{2^2}, \frac{1}{2}, \frac{1}{2^3}, \frac{1}{2^3}$ rithm, Determine the vere consider a rithm, Determine the vere consider a rithm.	ven where within the follows: 10, 0.15 ithm, Γ D-adic the Construction of the constru	strug ving so 5.0.25, Determ distril truct t the Co	nadows gles, structure $S = 0.35, 0.03$ into the Coution of the codew ding Efficiency less so	engtle en	h blos B, C, L }. Fin g Efficience sym- usign S v and I	soms 0, E, E d the ency a bols Shann Redun	ts ari  T} wit  Code  and R  A,B,C  on-Fa  dancy	h fo word edu C,D no-I	Beli llowinds usindand with	eve, p  ng prol  ng Sha  cy  probab  Coding	perse- pabili- nnon- pilities	1
9	onward, e vere, for vere, for vere, for vere, for vere, for vere consider that ties $P = \{0\}$ Fano Algor Consider a $\frac{1}{2^2}, \frac{1}{2}, \frac{1}{2^3}, \frac{1}{2^3}$ rithm, Determine Consider a probabilities	ven within the follow 10, 0.13 thm, Γ D-adic Construction Constructio	struggiving sc 5.0.25, Determined distributed to the Coefficient of the Coefficient of th	padows gles, structure $S = 0.35, 0.03$ into the Coution of the codeving Efficiency less so $(0.2)$ .	lengt engtl = {A, 2 3, 0.07 Coding f sour vords ciency	hen, oh blos B, C, L } . Fin g Efficience sym- usign S v and I with S=	doubte soms $P_0, E, F_1$ defined the ency and shann Redunction $P_0$	Ts ari Ts wit code and R A,B,C on-Fa dancy T,Z) w	h fo wordedu S,D mo-I	Beli llowinds usindan- with Elais	eve, point of the probability of	pabili- mon- polities galgo- ponding	
9	onward, e vere, for vere, for vere, for vere, for vere, for vere consider that ties $P = \{0\}$ Fano Algor Consider a $\frac{1}{2^2}, \frac{1}{2}, \frac{1}{2^3}, \frac{1}{2^3}$ rithm, Determined Consider a probabilities • Find	ven when within the follows and the follows are follows. The follows are follows are follows as $P=(0)$ the code within the follows are follows.	strug; ving so 5.0.25, Determ district truct to the Co e memo .5,0.3,0 ewords	paradows gles, structure $S = 0.35, 0.08$ in the Court of the codeve ding Efficiency less so $0.2$ ).	lengt engtl $= \{A, A, B, 0.07\}$ Coding f sour cords ciency burce v	h blos  B, C, L  S Efficience symmetric symmet	doubte soms $P_0, E, F_1$ defined the ency and shann Redunction $P_0$	Ts ari Ts wit code and R A,B,C on-Fa dancy T,Z) w	h fo wordedu S,D mo-I	Beli llowinds usindan- with Elais	eve, point of the probability of	pabili- mon- polities galgo- ponding	1
9	onward, e vere, for vere, for vere, for vere, for vere, for vere consider that ties $P = \{0\}$ Fano Algor Consider a $\frac{1}{2^2}, \frac{1}{2}, \frac{1}{2^3}, \frac{1}{2^3}$ rithm, Determined Consider a probabilities • Find	ven when within the follows and the follows are follows. The follows are follows are follows as $P=(0)$ the code within the follows are follows.	strug; ving so 5.0.25, Determ district truct to the Co e memo .5,0.3,0 ewords	padows gles, structure $S = 0.35, 0.03$ into the Coution of the codeving Efficiency less so $(0.2)$ .	lengt engtl $= \{A, A, B, 0.07\}$ Coding f sour cords ciency burce v	h blos  B, C, L  S Efficience symmetric symmet	doubte soms $P_0, E, F_1$ defined the ency and shann Redunction $P_0$	Ts ari Ts wit code and R A,B,C on-Fa dancy T,Z) w	h fo wordedu S,D mo-I	Beli llowinds usindan- with Elais	eve, point of the probability of	pabili- mon- polities galgo- ponding	1
9	onward, e vere, for v Consider th ties $P = \{0$ Fano Algor Consider a $\frac{1}{2^2}, \frac{1}{2}, \frac{1}{2^3}, \frac{1}{2^3}$ rithm, Dete Consider a probabilitie • Find	ven when within the follow of	strug; ving sc 5.0.25, Determ distribute to the Co e memo .5,0.3,0 ewords	paradows gles, structure $S = 0.35, 0.08$ in the Court of the codeve ding Efficiency less so $0.2$ ).	lengt engtl $= \{A, A, B, 0.07\}$ Coding F sour cords ciency ource v	h blos  B, C, L  S Efficience symmetric symmet	soms  O, E, F  d the ency a bols  Shann  Redum  =(X,Y)	r's with code and RA,B,Con-Fadancy	h fo word edu: S,D mo-H	Belin	eve, point of the probability of	pabili- nnon- polities g algo- ending	1

Consider the following Source  $S = \{A, B, C, D, E, F\}$  with probabilities P =11 2  $\{0.4, 0.2, 0.2, 0.1, 0.08, 0.02\}$  Find the codewords and efficiency by using following algorithms. • Shannon's first encoding algorithm • Shannon-Fano Coding Algorithm • Shannon-Fano-Elias Coding Algorithm Compare their efficiencies and conclude the best algorithm with your inferences 12 Consider a discrete memoryless source with  $S = \{X, Y, Z\}$  with respective 1 probabilities  $P = \{0.6, 0.2, 0.2\}$  Find the codeword for the message 'Y X Z X Y' using arithemtic coding. 13 A Consider a discrete memoryless source with  $S = \{X, Y, Z\}$  with respective 1 probabilities  $P = \{0.6, 0.2, 0.2\}$  is used for transmission. The received arith-

metic codeword is 0.70464. Determine the message transmitted.