Name : M. N. Khan

ID : 2216080041

8th Batch (CSE)

Course code : CSE-443

Course :- Mobile and Telecommunication

Ans: to the Q: NO: 01

(a) Ans: Here is the drawing of basic communication system:-

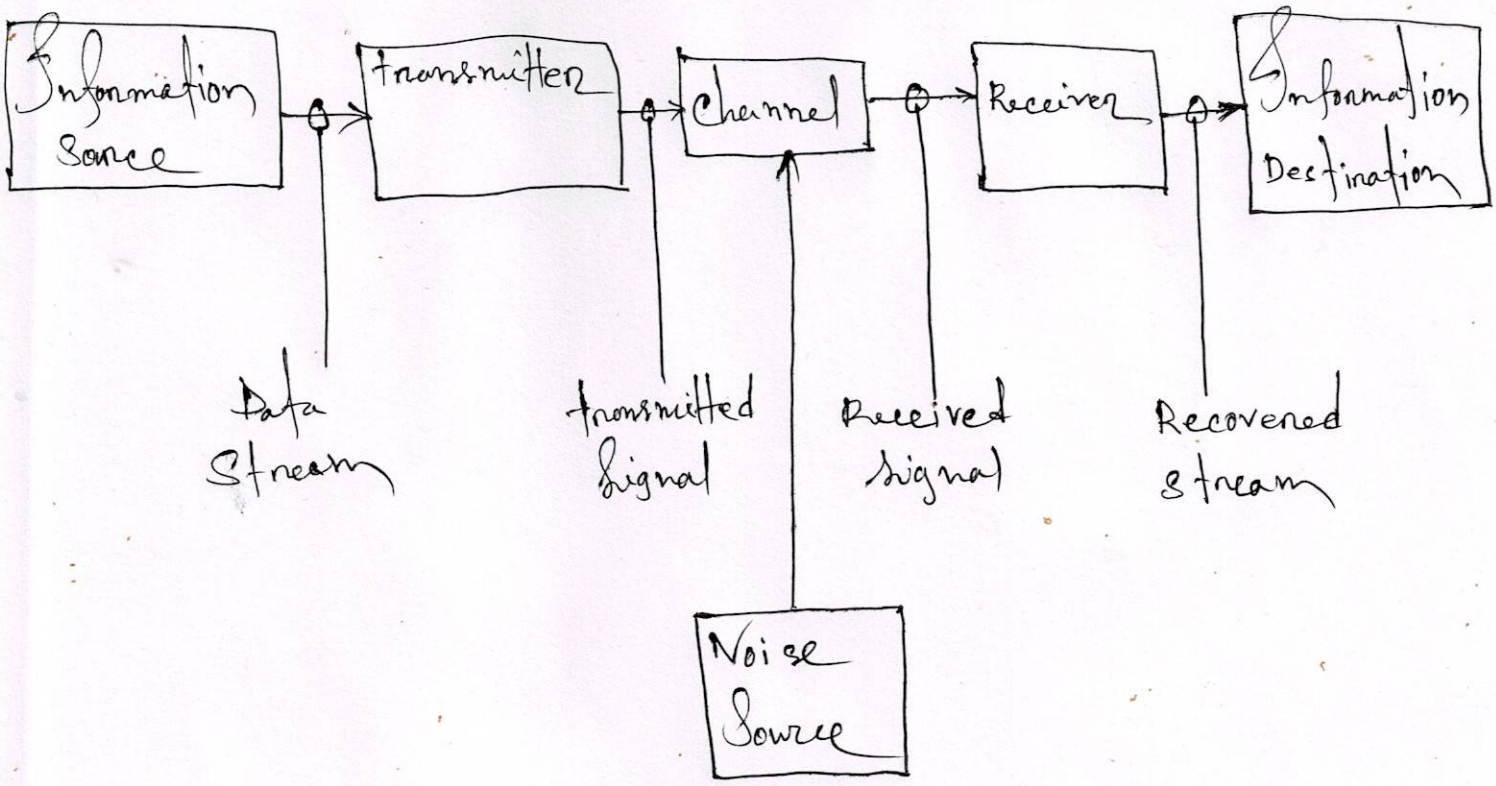


figure: Block diagram of a basic communication system.

Definition :-

The basic communication system is a system which describes the information exchange between two points the process of transmission and reception of information is called communication. Major elements are transmitter, channel and the receiver.

Ans: to the Q: NO: ~~02~~ 01

(b) Ans:

Here, given,

$$H = \frac{I_T}{L}$$

And also,

$$= \sum_{i=1}^{K} L P_i \log_2 \left(\frac{1}{P_i} \right)$$

P.T.O

Given,

$$H = \frac{I_T}{L}$$

$$\Rightarrow I_T = H \propto L$$

$$\Rightarrow I_P = \left(L_i P_i \log_2\left(\frac{1}{P_i}\right) + L_2 P_2 \log_2\left(\frac{1}{P_2}\right) + L_3 P_3 \log_2\left(\frac{1}{P_3}\right) + L_4 P_4 \log_2\left(\frac{1}{P_4}\right) + L_5 P_5 \log_2\left(\frac{1}{P_5}\right) + \ldots\ldots\right) \propto \left(L_1 P_1 \times n_1 + L_2 P_2 \times n_2 + L_3 P_3 \times n_3 + L_4 P_4 \times n_4 + L_5 P_5 \times n_5 + L_6 P_6 \times n_6 + \ldots\right)$$

Ans: to the Q: NO: 02 (a)

(i)

a | aa | b | bb | ab | aba | ba | bbb | baa | a b ab | ab |
1 2 3 4 5 6 7 8 9 10 11

a → 0 , b = 1

position	1	2	3	4	5	6	7	8	9	10	11
Sequence	a	aa	b	bb	ab	aba	ba	bbb	baa	abab	ab
Numerical no	1a	2b	1b	5a	3a	4b	7a	6b	5		
code	000	10	001	101	11	1010	110	1001	1110	1101	101

(ii) Decoding the Lempel-Ziv encoded sequence-

P q 10 2q 3q 4p 5p 4q 6p

codeword	Information bit	location
P	P	1
q	q	2
1P	PP	3
2q	qq	4
3q	PPq	5
4p	qqP	6
5p	PPqP	7
4q	qqq	8
6p	qqPP	9

Now, Information :- P q PP qq PPq qqP PPqP qqq qqPP

Ans: to the Q NO: 03

(a)

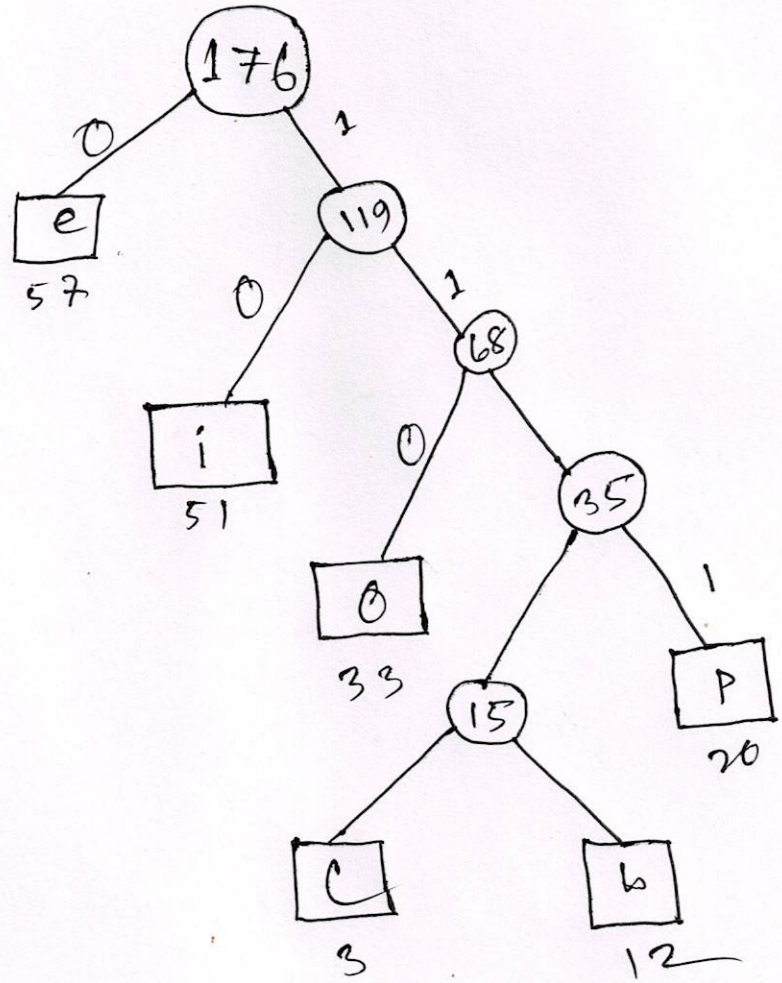
e	i	o	p	b	c
↓	↓	↓	↓	↓	↓
57	51	33	20	12	3

M = 57 + 51 + 33 + 20 + 12 + 3 = 176

e = 000 o = 010 b = 100

i = 001 p = 011 c = 101

Now,



Again,

c = 0

i = 10

o = 110

p = 1111

b = 11101

c = 11100

57 * 1 = 57

51 * 2 = 102

33 * 3 = 99

20 * 4 = 80

12 * 5 = 60

3 * 5 = 15

413 bits

Now,

Average bits required to represent each characters = $\frac{413}{176}$ = 2.34 bits/character.

~~Solution~~

efficiency:

c	i	o	p	b	c
↓	↓	↓	↓	↓	↓
57	51	33	20	12	3

P.T.O

Solution:

Message	Probability	1st Reduction	2nd Reduction	3rd Reduction	4th Reduction
e	57	57 00	57 00	57 00	68 1
i	51	51 01	51 01	51 01	57 00
o	33	33 11	33 11	35 10	51 01
p	20	20 100	20 100	33 11	
b	12	12 1010	15 101		
c	3	3 1011			

Now,

$e = 57$, $c_1 = 00$, $n_1 = 2$

$i = 51$, $c_2 = 01$, $n_2 = 2$

$o = 33$, $c_3 = 11$, $n_3 = 2$

$p = 20$, $c_4 = 100$, $n_4 = 3$

$b = 12$, $c_5 = 1010$, $n_5 = 4$

$c = 3$, $c_6 = 1011$, $n_6 = 4$

P.T.O

$$\text{efficiency}(\eta) = \frac{H(X)}{L}$$

$$\therefore H(X) = -P_1 \log_2 P_1 - P_2 \log_2 P_2 - P_3 \log_2 P_3 - P_4 \log_2 P_4 - P_5 \log_2 P_5 - P_6 \log_2 P_6$$

$$= -57 \log_2 57 - 51 \log_2 51 - 33 \log_2 33 - 20 \log_2 20 - 12 \log_2 12 - 3 \log_2 3$$

$$= -332.47 - 289.29 - 166.46 - 86.43 - 43.01 - 4.75$$

$$= -922.41$$

$$\therefore L = \sum_{k=1}^{6} = P(x_1)n_1 + P(x_2)n_2 + P(x_3)n_3 + P(x_4)n_4 + P(x_5)n_5 + P(x_6)n_6$$

$$= (57 \times 2) + (51 \times 2) + (33 \times 2) + (20 \times 3) + (12 \times 4) + (3 \times 4)$$

$$= (114 + 102 + 66 + 60 + 48 + 12) = 402$$

$$\text{efficiency} = \frac{H(X)}{L}$$

$$= \frac{-922.41}{402}$$

$$= -2.294$$

$$\therefore \text{efficiency} = -2.294$$

(b) Given,

$M_1 = \frac{1}{2}, M_2 = \frac{1}{8}, M_3 = \frac{1}{8}, M_4 = \frac{1}{4}$

$\therefore$ Source entropy $= \sum_{k=1}^{M=4} M_k \log_2 \frac{1}{M_k}$

$= M_1 \log_2 \frac{1}{M_1} + M_2 \log_2 \frac{1}{M_2} + M_3 \log_2 \frac{1}{M_3} + M_4 \log_2 \frac{1}{M_4}$

$= \frac{1}{2} \log_2 2 + \frac{1}{8} \log_2 8 + \frac{1}{8} \log_2 8 + \frac{1}{4} \log_2 4$

$= 1.75$ bits/symbol

$\therefore$ System entropy = 1.75 bits/symbol

Ans to the Q. NO: 04 (a)

Solution:

$P(m_1) = 0.4$, $P(M_2) = 0.2$, $P(m_3) = 0.12$, $P(M_4) = 0.08$, $P(m_5) = 0.08$

$P(M_6) = 0.06$ $P(M_7) = 0.06$

Message M_i	Probability $P(M_i)$	Step 1	Step 2	Step 3	Step 4	Code	no. of bits (n_i)
M_1	0.4	0	0			00	2
M_2	0.2	0	1			01	2
M_3	0.12	1	0			10	2
M_4	0.08	1	1	0	0	1100	4
M_5	0.08	1	1	0	1	1101	4
M_6	0.06	1	1	1	0	1110	4
M_7	0.06	1	1	1	1	1111	4

∴ coding efficiency = $\frac{H(x) \rightarrow \text{entropy}}{L \rightarrow \text{code length}}$

$$H(x) = -\sum_{k=1}^{7} P_k \log_2 P_k$$

$$= -0.4 \log_2 0.4 - 0.2 \log_2 0.2 - 0.12 \log_2 0.12 - 0.08 \log_2 0.08 - 0.08 \log_2 0.08 - 0.06 \log_2 0.06 - 0.06 \log_2 0.06$$

$$= 0.528 + 0.464 + 0.367 + 0.291 + 0.291 + 0.243 + 0.243$$

$$= 2.427 \text{ bits/symbol}$$

∴ Code length $(L) = \sum_{k=1}^{7} P(x_i)\, n_i$

$$= (0.4 \times 2) + (0.2 \times 2) + (0.12 \times 2) + (0.08 \times 4) + (0.08 \times 4) + (0.06 \times 4) + (0.06 \times 4)$$

$$= 2.56 \text{ letters/message}$$

Now coding efficiency = $\frac{2.427}{2.56}$

$$= 0.94 = 0.94 \times 100\%$$

$$= 94\%$$

∴ coding efficiency = 94%