

Soln  $\rightarrow P(x_1) = P(x_2) = 0.5$

$$P(y_1) = 0.9 P(x_1) + 0.2 P(x_2) \rightarrow (1)$$

$$P(y_2) = 0.1 P(x_1) + 0.8 P(x_2) \rightarrow (2)$$

$$P(z_1) = 0.9 P(y_1) + 0.2 P(y_2) \rightarrow (3)$$

$$P(z_2) = 0.1 P(y_1) + 0.8 P(y_2) \rightarrow (4)$$

put the value of  $P(y_1)$  &  $P(y_2)$  from eq<sup>n</sup> (1) & (2)  
to eq<sup>n</sup> (3) & (4) we get  $\rightarrow$

$$P(z_1) = 0.9 \{ 0.9 P(x_1) + 0.2 P(x_2) \} + 0.2 \{ 0.1 P(x_1) + 0.8 P(x_2) \}$$

$$P(z_1) = 0.81 P(x_1) + 0.18 P(x_2) + 0.02 P(x_1) + 0.16 P(x_2)$$

$$\boxed{P(z_1) = 0.83 P(x_1) + 0.34 P(x_2)} \rightarrow (5)$$

$$P(z_2) = 0.1 \{ 0.9 P(x_1) + 0.2 P(x_2) \} + 0.8 \{ 0.1 P(x_1) + 0.8 P(x_2) \}$$

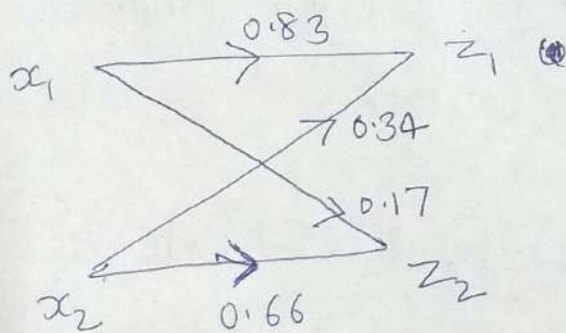
$$P(z_2) = 0.09 P(x_1) + 0.02 P(x_2) + 0.08 P(x_1) + 0.64 P(x_2)$$

$$\boxed{P(z_2) = 0.17 P(x_1) + 0.66 P(x_2)} \rightarrow (6)$$

from eq<sup>n</sup> (5) & (6)  $\rightarrow$

$$\begin{bmatrix} P(z_1) \\ P(z_2) \end{bmatrix} = \begin{bmatrix} P(x_1) & P(x_2) \end{bmatrix} \begin{bmatrix} 0.83 & 0.34 \\ 0.17 & 0.66 \end{bmatrix} \rightarrow (7)$$

channel diagram  $\rightarrow$



(ii) put the value of  $P(x_1) = P(x_2) = 0.5$  in eq<sup>n</sup> (7)  
we get

$$\begin{bmatrix} P(z_1) \\ P(z_2) \end{bmatrix} = \begin{bmatrix} 0.5 & 0.5 \end{bmatrix} \begin{bmatrix} 0.83 & 0.34 \\ 0.17 & 0.66 \end{bmatrix}$$

$$P(z_1) = 0.585$$

$$P(z_2) = 0.415$$



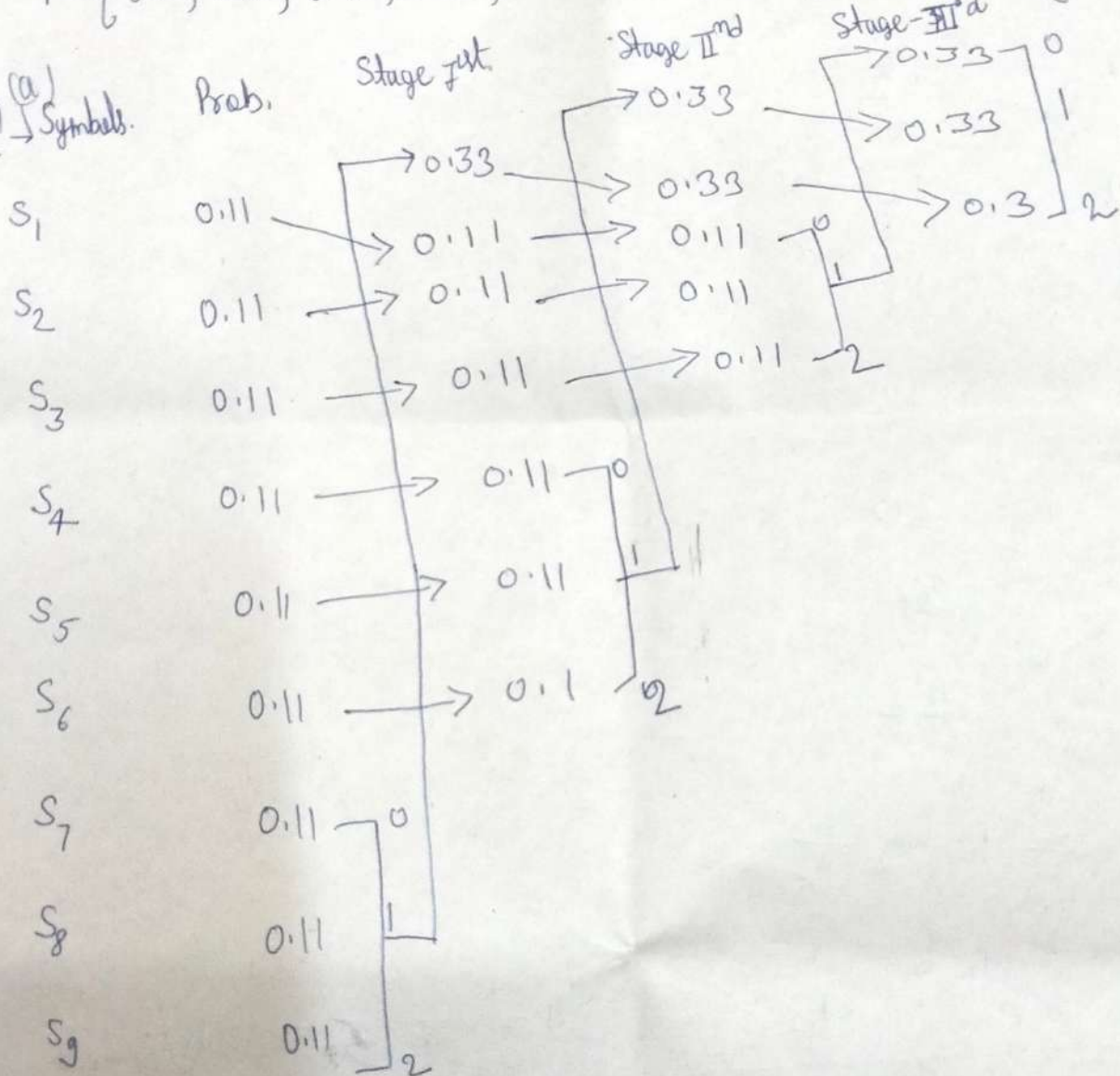
Q. A source produces 9 symbols  $\{S_1, S_2, \dots, S_9\}$  construct Ternary, Quaternary

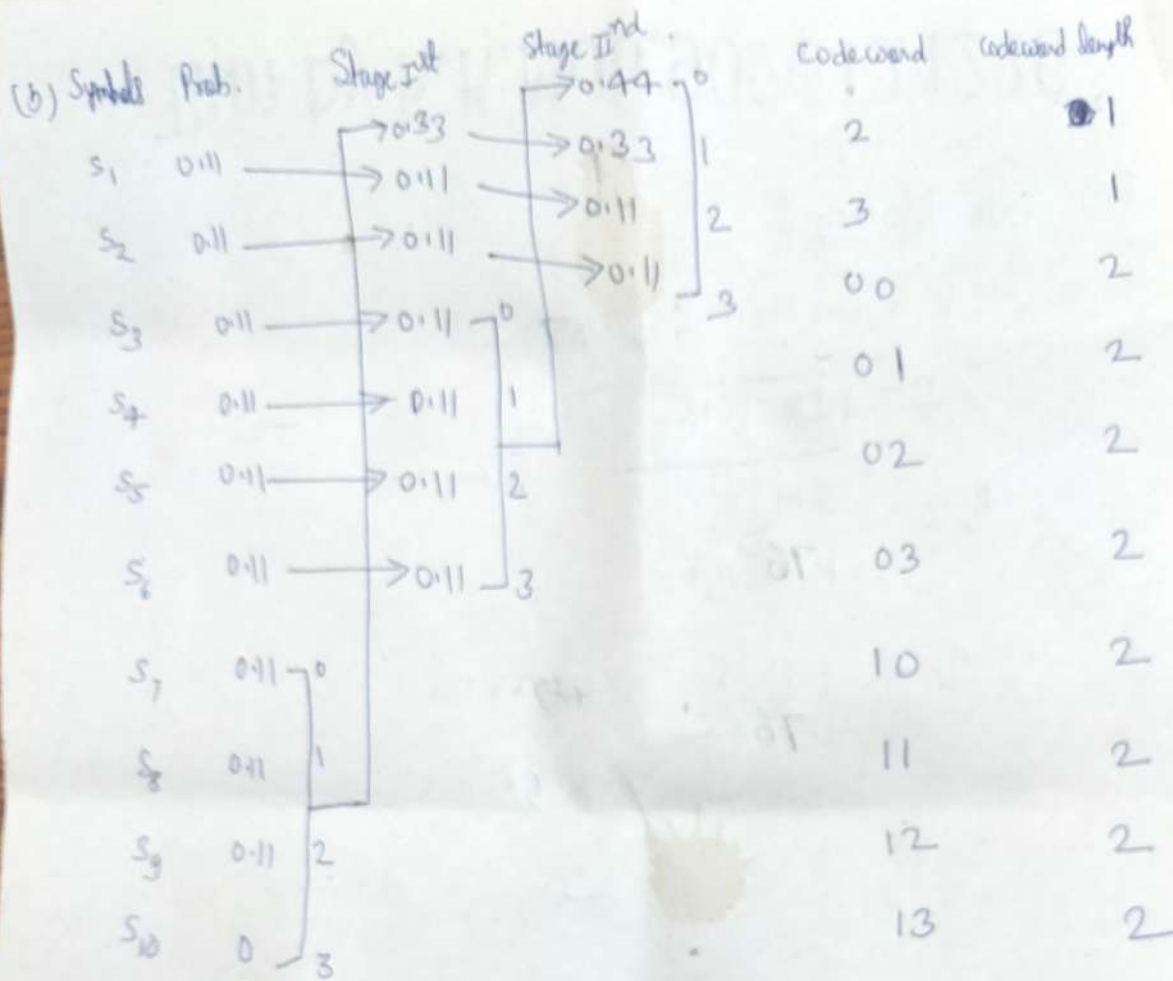
(i) Huffman coding by moving symbols as high as possible.

~~ii) And also find code efficiency.~~ (ii) And also find code efficiency.

$P = \{0.11, 0.11, 0.11, 0.11, 0.11, 0.11, 0.11, 0.11, 0.11\}$

Sol<sup>n</sup> (a)  
 $\rightarrow$  Symbols.





$$H = 3.1525 \text{ bits/symbol}$$

(ii) Code efficiency  $\rightarrow$  (a)  $H = 3.1525$

$$L = 2 \times 0.11 \times 9$$

$$L = 1.98 \text{ bits/symbol}$$

$$\eta = \frac{H}{L \log_2 3} = \frac{3.1525}{1.98 \times \log_2 3} = \frac{3.1525}{3.138} = 1 = 100\%$$

(b) code efficiency  $\rightarrow$

$$L = 0.11 + 0.11 + 0.11 \times 7 \times 2$$

$$L = ~~1.76~~ 1.76$$

$$\eta = \frac{3.1525}{1.76 \log_2 4}$$

$$\eta = \frac{3.1525}{1.76 \times 2} = ~~0.8955~~ \\ = 89.5\%$$

Ans