$$[00\ \ 00\ \ 00\ \ 00\ \ 11\ \ 10\ \ 11]$$

$$C = [d][G]$$
$$= [10011][G]$$

$$\boxed{C = [11 \,\vdots\, 10 \,\vdots\, 11 \,\vdots\, 11 \,\vdots\, 01 \,\vdots\, 01 \,\vdots\, 11]}$$

P) Consider a $(3,1,2)$ convolution code with $g^{(1)} = 110$, $g^{(2)} = 101$ and $g^{(3)} = 111$.

a) Draw the encoder block diagram

b) Find the generator matrix

c) Find the code word corresponding to $d = 11110$ using ... ch.

$$
G = \begin{bmatrix}
111 & 101 & 011 & 000 & 000 & 000 & 000 & 000 \\
000 & 111 & 101 & 011 & 000 & 000 & 000 & 000 \\
000 & 000 & 111 & 101 & 011 & 000 & 000 & 000 \\
000 & 000 & 000 & 111 & 101 & 011 & 000 & 000 \\
000 & 000 & 000 & 000 & 111 & 101 & 011 & 000 \\
000 & 000 & 000 & 000 & 000 & 111 & 101 & 011
\end{bmatrix}
$$

$$d = [111101]$$

$$C = [d][G]$$

$$= [111 \vdots 010 \vdots 001 \vdots 001 \vdots 110 \vdots 100 \vdots 101 \vdots 011]$$

* TRANSFORM DOMAIN METHOD :-

For j no of modulo-2 adders (where j varies from 1 to n), the Generator Polynomial is

$$g^j(x) = g_1^j + x g_2^j + x^2 g_3^j + x^3 g_4^j + \ldots\ldots + x^m g_{m+1}^j$$

where $j \rightarrow 1$ to n

The corresponding o/p of each of the adder is given by $C^j(x) = d(x)\, g^j(x)$.

where $d(x)$ is message vector polynomial.

After getting the polynomials at the o/p of each of the adder, the final encoder o/p polynomial is obtained in the form

$$c(x) = c^{(1)}(x^n) + x\, c^{(2)}(x^n) + x^2 c^{(3)}(x^n) + \ldots + x^{n-1} c^{(n)}(x^n)$$

obtained in the form

$$c(x) = c^{(1)}(x^n) + x\,c^{(2)}(x^n) + x^2 c^{(3)}(x^n) + \dots + x^{n-1} c^{(n)}(x^n)$$

p) $g^{(1)} = 1011$

$g^{(2)} = 1111$

$$g^{(1)}(x) = 1 + 0.x + 1.x^2 + 1.x^3 = 1 + x^2 + x^3$$

$$g^{(2)}(x) = 1 + 1.x + 1.x^2 + 1.x^3 = 1 + x + x^2 + x^3$$

$d = 10111$

$$d(x) = 1 + 0.x + 1.x^2 + 1.x^3 + 1.x^4 = 1 + x^2 + x^3 + x^4$$

$$c^{(1)}(x) = d(x)\,g^{(1)}(x)$$

$$= (1 + x^2 + x^3 + x^4)(1 + x^2 + x^3)$$

$$= 1 + \cancel{x^2} + \cancel{x^3} + \cancel{x^2} + \cancel{x^4} + \cancel{x^5} + \cancel{x^3} + \cancel{x^5} + x^6 + \cancel{x^4} + x^6 + \dots$$

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$$c^{(2)}(x) = d(x)\, g^{(2)}(x)$$
$$= (1+x^2+x^3+x^4)(1+x+x^2+x^3)$$
$$= 1+x+\cancel{x^2}+\cancel{x^3}+\cancel{x^2}+\cancel{x^3}+\cancel{x^4}+\cancel{x^5}+x^3+\cancel{x^4}+\cancel{x^5}+\cancel{x^6}$$
$$+x^4+x^5+\cancel{x^6}+x^7$$
$$= 1+x+x^3+x^4+x^5+x^7$$

$$C(x) = c^{(1)} x^n + x\, c^{(2)} x^n$$
$$= c^{(1)}(x)^2 + x\, c^{(2)}(x)^2$$
$$\cancel{= (1+x^7)x^2 + x(1+x+x^3+x^4+x^5+x^7)x^8}$$
$$\cancel{= x^2+x^9+}$$
$$= (1+x^7)^2 + x\,(1+x+x^3+x^4+x^5+x^7)^2$$
$$= 1+x^{14} + x(1+x^2+x^6+x^8+x^{10}+x^{14})$$
$$= 1+x^{14}+x+x^3+x^7+x^9+x^{11}+x^{15}$$
$$= 1+x+x^3+x^7+x^9+x^{11}+x^{14}+x^{15}$$

$$= 1+x+x^{2}+x^{4}+x^{8}+x^{11}+x^{12}+x^{13}+x^{15}+x^{18}+x^{20}+x^{22}+x^{23}$$

$$C = [111,010,001,001,110,100,101,011]$$

* STATE DIAGRAM & CODE TREE:-

P) Consider the binary convolution encoder shown in the figure. Draw the state table, state transition table, state diagram & corresponding code tree. Using the code tree, find the encoded sequence for the message 10111.