Inverse Z Transform

Methods for obtaining IZT

1. Power series expansion
2. Partial fraction expansion
3. Residue method.

Power Series Expansion Method →

is also called long division method or direct division method

$$X(Z) = a_0 + a_1 Z^{-1} + a_2 Z^{-2} + \dots a_n Z^{-n}$$

$$X(Z) = \sum_{n=-\infty}^{\infty} x(n) Z^{-n}$$

If sequence is causal then limits of n

$$X(Z) = \sum_{n=0}^{\infty} x(n) Z^{-n}$$

$$X(Z) = x(0) Z^{0} + x(1) Z^{-1} + x(2) Z^{-2} + \dots x(n) Z^{-n}$$

$x(0) = a_0$; $x(0) = a_1$ -- $x(n) = a_n$

$x(n) = a_n \quad n \geq 0$

Rules of Power Series Expension →

In case of anti causal sequence carryout the long division by writing the polynomials in the reverse order that means starting with the most negative term on left

$|Z| < 1$

In case of causal sequence, carryout the long division without changing order of the polynomial. That means starting with the most +ve term on the left.

using power series method for determining Inverse Z transform (IZT) of

$$X(Z) = \frac{1}{1 - 1.5Z^{-1} + 0.5Z^{-2}}$$

for ROC $|Z| > 1$ ROC $|Z| < 0.5$

$$\begin{array}{r|l}
 & 1 + 1.5Z^{-1} + 1.75Z^{-2} + 1.875Z^{-3} \\
\hline
1 - 1.5Z^{-1} + 0.5Z^{-2} & 1 \\
 & 1 - 1.5Z^{-1} + 0.5Z^{-2} \\
 & + \phantom{1.5Z^{-1}} - \\
\hline
 & 1.5Z^{-1} - 0.5Z^{-2} \\
 & 1.5Z^{-1} - 2.25Z^{-2} + 0.75Z^{-3} \\
 & \phantom{1.5Z^{-1}} + \phantom{2.25Z^{-2}} - \\
\hline
 & 1.75Z^{-2} - 0.75Z^{-3} \\
 & 1.75Z^{-2} - 2.625Z^{-3} + 0.85Z^{-4} \\
 & - \phantom{1.75Z^{-2}} + \phantom{2.625Z^{-3}} - \\
\hline
 & 1.875Z^{-3} - 0.85Z^{-4} \\
 & 1.875Z^{-3} - 2.812Z^{-4} + 0.93Z^{-5} \\
 & - \phantom{1.875Z^{-3}} + \phantom{2.812Z^{-4}} - \\
\hline
 & 1.962Z^{-4} - 0.93Z^{-5}
\end{array}$$

$$x(Z) = 1 + 1.5Z^{-1} + 1.75Z^{-2} + 1.875Z^{-3} + 1.962Z^{-4}$$

$$x(Z) = \sum_{n=0}^{\infty} x(n) Z^{-n}$$

$\{1, 1.5, 1.75, 1.875, 1.962\}$

$$X(Z) = \frac{1}{0.5Z^{-2} - 1.5Z^{-1} + 1}$$

$$
\begin{array}{r|l}
 & 2Z^2 + 6Z^3 + 14Z^4 + 30Z^5 \\
\hline
0.5Z^{-2} - 1.5Z^{-1} + 1 & 1 \\
 & 1 - 3Z + 2Z^2 \\
 & \overline{\quad 3Z - 2Z^2} \\
 & 3Z - 9Z^2 + 6Z^3 \\
 & \overline{\quad 7Z^2 - 6Z^3} \\
 & 7Z^2 - 21Z^3 + 14Z^4 \\
 & \overline{\quad 15Z^3 - 14Z^4} \\
 & 15Z^3 - 45Z^4 + 30Z^5 \\
 & \overline{\quad 31Z^4 - 30Z^5}
\end{array}
$$

$$X(Z) = 2Z^2 + 6Z^3 + 14Z^4 + 30Z^5$$

$$X(Z) = \sum_{n=-1}^{-\infty} x(Z) Z^{-n}$$

$$x(n) = \{30, 14, 6, 2, 0, \underset{\uparrow}{0}\}$$

$X(Z) = \frac{Z}{Z-1} \quad |Z| > 1$

$X(Z) = \frac{Z}{Z-a} \quad \frac{Z}{-a+Z}$

Partial Fraction Expansion (P.F.E) Method $\Rightarrow$

$$X(Z) = \frac{N(Z)}{D(Z)} = \frac{b_0 + b_1 Z^{-1} + b_2 Z^{-2} + \ldots b_M Z^{-M}}{a_0 + a_1 Z^{-1} + a_2 Z^{-2} + \ldots a_N Z^{-N}}$$

Steps 1. Check given fn in proper form or not

(i) The Co efficient a_0 in eq^n should be equal to 1 if $a_0 \neq 1$ then adjust polynomials

(ii) $a_n \neq 1$ and $M \geq N$. the long division is called out to make $M < N$.

Step 2: Multiply numerator & denominator by Z^N, Means convert the fn in term of +ve power of Z.

③ obtain eqn $\frac{X(Z)}{Z}$

④ Fraction the denominator & obtain the roots.
$(Z-P_1)(Z-P_2)\cdots(Z-P_N)\cdots$ P_1, P_2, P_N called as poles

⑤ Write down the eq'n in partial fraction expansion form

$$\frac{X(Z)}{Z} = \frac{A_1}{Z-P_1} + \frac{A_2}{Z-P_2} + \cdots + \frac{A_N}{Z-P_N}$$

Here $A_1, A_2 \cdots A_K$. The Co-efficient A_K is calculated as

$$A_K = (Z-P_K)\left.\frac{X(Z)}{Z}\right|_{Z=P_K}$$

⑥ By Calculating values of $A_1, A_2, \cdots A_N$ transfer Z to R.H.S
Now standard Z transforms pairs to obtain inverse Z transform

$$a^n u(n) \longrightarrow \frac{Z}{Z-a} \quad |Z| > |a|$$

$$-a^n u(-n-1) \longrightarrow \frac{Z}{Z-a} \quad |Z| < |a|$$

$$x(n) = IZT\ \frac{Z}{Z-P_K} = (P_K)^n u(n) \quad |Z| > |P_K|$$

$$x(n) = IZT\ \frac{Z}{Z-P_K} = -(P_K)^n u(-n-1) \quad |Z| < |P_K|$$

Find inverse Z of the following

$$X(Z) = \frac{1 - \frac{1}{2}Z^{-1}}{1 + \frac{3}{4}Z^{-1} + \frac{1}{8}Z^{-2}} \quad |Z| > \frac{1}{2}$$

Step 1 Check whether given fn is in proper form

$a_0 = 1$, $M = 1$, $N = 2$

$M < N$ and $a_0 = 1$

Step 2 →

$$X(z) = \frac{1 - \frac{1}{2} z^{-1}}{1 + \frac{3}{4} z^{-1} + \frac{1}{8} z^{-2}}$$

$$X(z) = \frac{z^2 [1 - 1/2 z^{-1}]}{z^2 [1 + \frac{3}{4} z^{-1} + \frac{1}{8} z^{-2}]}$$

$$X[z] = \frac{z^2 - \frac{1}{2} z}{z^2 + \frac{3}{4} z + \frac{1}{8}} \Rightarrow z\left[z - \frac{1}{2}\right]$$

Step 3 →

$$\frac{X(z)}{z} = \frac{\cancel{z}(z - \frac{1}{2})}{z^2 + \frac{3}{4} z + \frac{1}{8}}$$

Step 4 →

$$P_1, P_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$z^2 + \frac{3}{4} z + \frac{1}{8} \qquad a = 1, \; b = \frac{3}{4} \quad c = \frac{1}{8}$$

$$P_1, P_2 = \frac{-\frac{3}{4} \pm \sqrt{\frac{9}{16} - 4(1 \times \frac{1}{8})}}{2 \times 1} = \frac{-\frac{3}{4} \pm \sqrt{\frac{9}{16} - \frac{1}{2}}}{2}$$

$$P_1, P_2 = \frac{-\frac{3}{4} \pm \sqrt{\frac{9-8}{16}}}{2} = \frac{-\frac{3}{4} \pm \frac{1}{4}}{2} = -\frac{3}{8} \pm \frac{1}{8}$$

$P_1 = -1/2$

$P_2 = -1/4$

step-5

$$\frac{X(Z)}{Z} = \frac{Z-\frac{1}{2}}{(Z-P_1)(Z-P_2)} = \frac{Z-\frac{1}{2}}{(Z+\frac{1}{2})(Z+\frac{1}{4})}$$

$$\frac{X(z)}{Z} = \frac{A_1}{(Z+\frac{1}{2})} + \frac{A_2}{(Z+\frac{1}{4})}$$

step-6 obtain values of A_1 & A_2

$$A_K = (Z-P_K)\frac{X(z)}{Z}\Big|_{Z=P_K}$$

$$A_1 = (Z-P_1)\frac{X(z)}{Z}\Big|_{Z=P_1}$$

$$P_1 = -1/2$$

$$A_1 = (Z+\frac{1}{2})\frac{X(z)}{Z}\Big|_{Z=-\frac{1}{2}}$$

$$A_1 = \frac{Z-\frac{1}{2}}{Z+\frac{1}{4}}\Big|_{Z=-\frac{1}{2}} \quad \frac{-\frac{1}{2}-\frac{1}{2}}{-\frac{1}{2}+\frac{1}{4}} \quad \frac{-1}{\frac{-2+1}{4}} = \frac{\cancel{-1}}{\frac{\cancel{-1}}{4}} = 4$$

$$A_2 = \frac{Z-\frac{1}{2}}{Z+\frac{1}{2}}\Big|_{Z=\frac{-1}{4}} \quad \frac{-\frac{1}{4}-\frac{1}{2}}{-\frac{1}{4}+\frac{1}{2}} \quad \frac{\frac{-1-2}{4}}{\frac{-1+2}{4}} = \frac{\frac{-3}{4}}{\frac{+1}{4}} \quad \frac{-3}{4}\times\frac{4}{1} = -3$$

$$A_1 = 4, \quad A_2 = -3$$

step 7 →

$$\frac{X(Z)}{Z} = \frac{4}{Z+\frac{1}{2}} - \frac{3}{Z+\frac{1}{4}}$$

$$X(Z) = \frac{4Z}{Z+\frac{1}{2}} - \frac{3Z}{Z+\frac{1}{4}}$$

Step 8 The 1^{st} term of eqn (7) is $4 \cdot \frac{z}{z+\frac{1}{2}}$, Causal when $|z| > \frac{1}{2}$

$$IZT\left[\frac{z}{z-P_K}\right] = (P_K)^n u(n) \qquad |z| > |P_K|$$

$$IZT \; \frac{z}{z+\frac{1}{2}} = \left(-\frac{1}{2}\right)^n u(n)$$

$$IZT \; \frac{z}{z+\frac{1}{4}} = \left(\frac{-1}{4}\right)^n u(n)$$

$$x(n) = 4\left(-\frac{1}{2}\right)^n u(n) - 3\left(\frac{-1}{4}\right)^n u(n)$$

Determine all possible sequences x(n) associated with Z transform

$$X(Z) = \frac{5z^{-1}}{(1-2z^{-1})(3-z^{-1})}$$

$$X(Z) = \frac{5z^{-1}}{3-7z^{-1}-2z^{-2}}$$

$M=1$, $N=2$ $\quad M<N \quad a_0=3$ we want $a_0=1$

$$\frac{\frac{5}{3}z^{-1}}{1-\frac{7}{3}z^{-1}-\frac{2}{3}z^{-2}}$$

Step 2 $$X(z) = \frac{\frac{5}{3}z}{z^2-\frac{7}{3}z-\frac{2}{3}}$$

Step 3 $$\frac{X(Z)}{Z} = \frac{\frac{5}{3}}{z^2-\frac{7}{3}z-\frac{2}{3}}$$

step 4 $\quad P_1 = 2 \qquad P_2 = \frac{1}{3}$

step 5 $\quad \frac{X(Z)}{Z} = \frac{\frac{5}{3}}{(Z-2)(Z-\frac{1}{3})}$

$$\frac{X(Z)}{Z} = \frac{A_1}{Z-2} + \frac{A_2}{Z-\frac{1}{3}}$$

step 6 $\quad A_1 = \left.\frac{\frac{5}{3}}{(Z-\frac{1}{3})}\right|_{Z=2} = \frac{\frac{5}{3}}{2-\frac{1}{3}} = \frac{\frac{5}{3}}{5/3} = 1$

$$A_2 = \left.\frac{5/3}{(Z-2)}\right|_{Z=\frac{1}{3}} = \frac{5/3}{1/3-2} = \frac{5/3}{-5/3} = -1$$

step 7 $\quad \frac{X(Z)}{Z} = \frac{1}{Z-2} - \frac{1}{Z-3}$

$$X(Z) = \frac{Z}{Z-2} - \frac{Z}{Z-\frac{1}{3}}$$

(i) when ROC $|Z| > 2$ $\quad = 2^n u(n) - \left(\frac{1}{3}\right)^n u(n)$

(ii) when ROC is $2 > |Z| > 1/3$

$$-(2)^n u(-n-1) + \left(\frac{1}{3}\right)^n u(n)$$

(iii) when ROC $|Z| < \frac{1}{3}$

$$-(2)^n u(-n-1) - \left(\frac{1}{3}\right)^n u(-n-1)$$

Determine IZT of

$$X(Z) = \frac{4Z^{-2} + 3Z^{-1} + 2}{\frac{1}{2}Z^{-2} - \frac{3}{2}Z^{-1} + 1} \quad \text{for Causal Sequence}$$

$a_0 = 1, \; M = 2, \; N = 2$

$$\begin{array}{r|l} & \quad 8 \\ \hline \frac{1}{2}Z^{-2} - \frac{3}{2}Z^{-1} + 1 & 4Z^{-2} + 3Z^{-1} + 2 \\ & 4Z^{-2} - 12Z^{-1} + 8 \\ & - \quad + \quad - \\ \hline & \quad 15Z^{-1} - 6 \end{array}$$

$$X(Z) = 8 + \frac{15Z^{-1} - 6}{\frac{1}{2}Z^{-2} - \frac{3}{2}Z^{-1} + 1}$$

$$X_1(Z) = \frac{15Z^{-1} - 6}{\frac{1}{2}Z^{-2} - \frac{3}{2}Z^{-1} + 1} \qquad M = 1, \; N = 2$$

$$\frac{15Z - 6Z^2}{\frac{1}{2} - \frac{3}{2}Z + Z^2} = \frac{-6Z^2 + 15Z}{Z^2 - \frac{3}{2}Z + \frac{1}{2}}$$

$$\frac{X(Z)}{Z} = \frac{-6Z + 15}{Z^2 - \frac{3}{2}Z + \frac{1}{2}}$$

Find inverse Z transform using convolution method

$$X(Z) = \frac{Z^2}{\left(Z - \frac{1}{4}\right)^2}, \quad \text{ROC } |Z| > \frac{1}{4}$$

According to Conv. property

$$x_1(n) * x_2(n) = X_1(Z) \cdot X_2(Z)$$

Let $X_1(Z) = \frac{Z}{Z-\frac{1}{4}}$ $\quad X_2(Z) = \frac{Z}{Z-\frac{1}{4}}$.

$$X(Z) = X_1(Z) \cdot X_2(Z)$$

We have Standard Z Transform formula

$$\alpha^n u(n) \xrightarrow{Z} \frac{Z}{Z-\alpha} \qquad |Z| > |a|$$

$$x_1(n) = \left(\frac{1}{4}\right)^n u(n) \qquad x_2(n) = \left(\frac{1}{4}\right)^n u(n)$$

$$x(n) = x_1(n) * x_2(n)$$

According to defination of Convolution

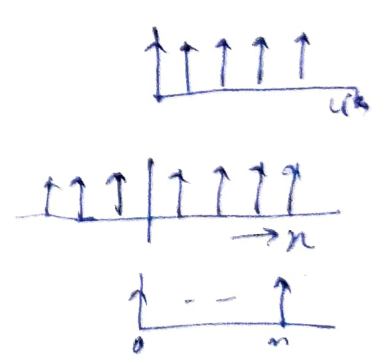
$$x(n) = x_1(n) * x_2(n) = \sum_{k=-\infty}^{\infty} x_1(k)\, x_2(n-k)$$

$$x_1(k) = \left(\frac{1}{4}\right)^k u(k) \qquad x_2(n-k) = \left(\frac{1}{4}\right)^{n-k} u(n-k)$$

$$x(n) = \sum_{k=-\infty}^{\infty} \left(\frac{1}{4}\right)^k u(k) \cdot \left(\frac{1}{4}\right)^{n-k} u(n-k)$$

$$= \sum_{k=-\infty}^{\infty} \cancel{\left(\frac{1}{4}\right)^k} \cdot \left(\frac{1}{4}\right)^n \cdot \cancel{\left(\frac{1}{4}\right)^{-k}} u(k) \cdot u(-k+n)$$

$$x(n) = \left(\frac{1}{4}\right)^n \sum_{k=-\infty}^{\infty} u(k)\, u(-k+n)$$



$$\left(\frac{1}{4}\right)^n \sum_{k=0}^{n} 1$$

$$\rightarrow x(n) = \left(\frac{1}{4}\right)^n \cdot \sum_{k=0}^{n} (k)^0$$

$$\sum_{n=N_1}^{N_2} A^n = N_2 - N_1 + 1 \text{ for } A = 1$$

$$n - 0 + 1 = \boxed{n+1}$$

$$\rightarrow x(n) = \left(\frac{1}{4}\right)^n \cdot (n+1)\, u(n)$$

$$X(Z) = \frac{1}{1-3Z^{-1}+2Z^{-2}}$$

$$X(Z) = \frac{Z^2}{Z^2-3Z+2} = \frac{Z^2}{(Z-1)(Z-2)}$$

$$X_1(Z) = \frac{Z}{Z-1} \qquad X_2(Z) = \frac{Z}{Z-2}$$

$$x_1(n) * x_2(n) \longrightarrow X_1(Z) \cdot X_2(Z)$$

$$x_1(n) = u(n) \qquad x_2(n)\ 2^n u(n)$$

$$x(n) = \sum_{K=-\infty}^{\infty} x_1(k)\, x_2(n-k)$$

$$\sum_{K=-\infty}^{\infty} u(k)\, 2^{n-k} u(n-k)$$

$$\sum_{K=-\infty}^{\infty} u(k)\, 2^n \cdot 2^{-k}\, u(n-k)$$

$$2^n \sum_{K=-\infty}^{\infty} 2^{-K} u(k)\, u(n-k)$$

$$2^n \sum_{K=0}^{n} \left(\frac{1}{2}\right)^K \qquad \sum_{K=N_1}^{N_2} A^k = \frac{a^{N_1}-a^{N_2+1}}{1-a}$$

$$2^n\left[\frac{\left(\frac{1}{2}\right)^0-\left(\frac{1}{2}\right)^{n+1}}{1-1/2}\right] = 2^n\left[\frac{1-\left(\frac{1}{2}\right)^{n+1}}{\frac{2-1}{2}}\right]$$

$$2^n \cdot 2\left[1-\left(\frac{1}{2}\right)^{n+1}\right] \Rightarrow 2^{n+1}\left[1-\left(\frac{1}{2}\right)^{n+1}\right] u(n) \ \underline{\text{Ans}}$$

$|z| > 1$ using residue method

$$X(z) = \frac{1}{(z-1)(z-3)}$$

$$X(z) \cdot z^{n-1} = \frac{z^{n-1}}{(z-1)(z-3)}$$

Poles $z=1$, $z=3$

$$X(z) \cdot z^{n-1} = \frac{(1)^n \cdot (1)^{-1}}{(1-3)} \quad \frac{(1)^n \cdot 1}{-2} = 0.5\,(1)^n$$

$$\frac{(3)^n \cdot (3)^{-1}}{3-1} = \frac{(3)^n \cdot \frac{1}{3}}{2} \quad \frac{(3)^n \cdot 0.33}{2} = 0.17\,(3)^n$$

$$x(n) = -0.5(1)^n + 0.17(3)^n \quad \text{Ans}$$

Find $x(n)$ for given $X(Z)$ using Residue Method

$$X(Z) = \frac{10Z}{(Z-1)(Z-2)} \quad -(1)$$

step 1 Multiply both sides of eqn (1) by Z^{n-1}

$$X(Z) \cdot Z^{n-1} = \frac{10Z' \times Z^{n-1}}{(Z-1)(Z-2)} = \frac{10 \cancel{Z} \cdot Z^n \cdot \cancel{Z^{-1}}}{(Z-1)(Z-2)}$$

Step-2 Poles $P=1$, $P=2$

Thus residue at $Z=1$ is

$$R_{Z=1} = \frac{(Z^n 10)}{Z-2}\Big|_{Z=1} \quad \frac{10 \cdot (1)^n}{1-2}$$

$$R_{Z=1} = -10(1)^n$$

Residue at $Z=2$ is

$$R_{Z=2} = (\cancel{Z-}\cdot \frac{10Z^n}{Z-1}\Big|_{Z=2} \quad \frac{10(2)^n}{2-1}$$

$$R_{Z=2} = 10(2)^n$$

$$x(n) = -10(1)^n + 10(2)^n \quad \text{for } n \geq 0$$

Relationship b/w DFT & ZT $\Rightarrow$

$$X(Z) = \sum_{n=-\infty}^{\infty} x(n) Z^{-n}$$

We know that $Z = e^{jw}$

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) e^{-jwn}$$

Now Suppose $X(Z)$ is Sampled at 'N' equally spaced pts on the unit Circle.

$$W = \frac{2\pi K}{N}$$

$$Z = e^{j2\pi K/N}$$

$$X(Z) = \sum_{n=-\infty}^{\infty} x(n)\, e^{-j2\pi Kn/N} \quad \text{at } Z = e^{j2\pi K/N}$$

if causal sequence and has N no. of samples then we can write of

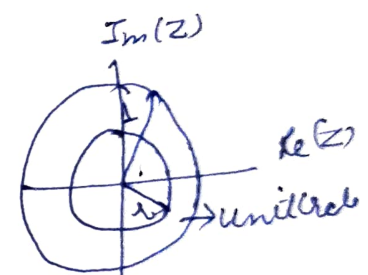
$$\boxed{x(k) = X(Z)} \rightarrow X(Z) = \sum_{n=0}^{N-1} x(n) e^{-j2\pi \frac{Kn}{N}}$$

<u>Condition for Causality and Stability in terms of Z transform</u>.

(1) For a causal system we know that ROC is exterior part of circle that means $|Z| > |r|$

(2) For stable ckt ROC must include unit circle. having Radius 1

$r < 1$



Combined Condition for causal & stable system

$$|Z| > r < 1$$

A Causal LTI system has transfer fn

$$H(Z) = \frac{(1-0.5Z^{-1})(1-Z^{-1})}{(1+0.2Z^{-1})(1+0.8Z^{-1})(1-0.8Z^{-1})}$$

(i) Give ROC Condition

(ii) Show pole zero diag of system

(iii) Find impulse response of system

(iv) Comment on system stability

$$H(Z) = \frac{(1-0.5Z^{-1})\ (1-Z^{-1})}{(1+0.2Z^{-1})(1+0.8Z^{-1})(1-0.8Z^{-1})}$$

To convert into the power of Z multiply N/D by Z^3

$$\frac{Z \cdot Z(1-0.5Z^{-1})\ Z\cdot(1-Z^{-1})}{Z(1+0.2Z^{-1})Z(1+0.8Z^{-1})Z(1-0.8Z^{-1})} \quad -(1)$$

$$\frac{Z\cdot(Z-0.5)(Z-1)}{(Z+0.2)(Z+0.8)(Z-0.8)} \quad -(2)$$

Poles at -0.2, -0.8, 0.8

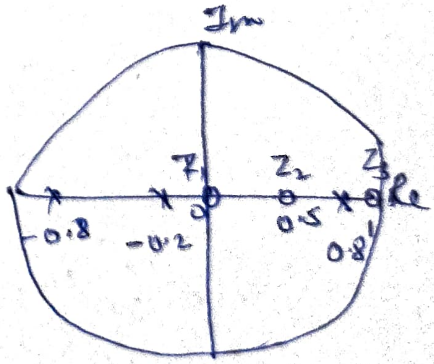
Requires roc $|Z| > 0.8$

The given system is causal

(ii) $$H(Z) = \left(\frac{(Z-Z_1)\cdot(Z-Z_2)\ (Z-Z_3)}{(Z-P_1)\ (Z-P_2)\ (Z-P_3)}\right. \quad -(3)$$

$Z_1 = 0$, $Z_2 = 0.5$, $Z_3 = 1$

$P_1 = -0.2$, $P_2 = -0.8$ $P_3 = +0.8$



(iii) $$\frac{H(Z)}{Z} = \frac{(Z-0.5)(Z-1)}{(Z+0.2)(Z+0.8)(Z-0.8)}$$

$$\frac{H(Z)}{Z} = \frac{A_1}{Z+0.2} + \frac{A_2}{Z+0.8} + \frac{A_3}{Z-0.8}$$

$$A_1 = \frac{(-0.2-0.5)(-0.2-1)}{((-0.2)+(0.8))(-0.2-0.8)}\bigg|_{z=-0.2}$$

$$= \frac{(-0.7)(-1.2)}{(0.6)(-1)} = -1.4$$

$$A_2 = \frac{(Z-0.5)(Z-1)}{(Z+0.2)(Z+0.8)}\bigg|_{Z=-0.8}$$

$$\frac{(-0.8-0.5)(-0.8-1)}{(-0.8-0.2)(-0.8-0.8)} = 2.44$$

$$A_3 = \frac{(Z-0.5)(Z-1)}{(Z+0.2)(Z+0.8)}\bigg|_{Z=0.8}$$

$$\frac{(0.8-0.5)(0.8-0.5)}{(0.8+0.2)(0.8+0.8} = -0.0375$$

$$\frac{H(Z)}{Z} = \frac{-1.4}{Z+0.2} + \frac{2.44}{Z+0.8} - \frac{0.0375}{Z-0.8}$$

$$HZ = \frac{-1.4Z}{Z+0.2} + \frac{2.44Z}{Z+0.8} - \frac{0.0375Z}{Z-0.8}$$

$$h(n) = -1.4(0.2)^n u(n) + 2.44(-0.8)^n u(n) - 0.0375(0.8)^n u(n)$$

All the poles lie inside the unit circle so system is stable