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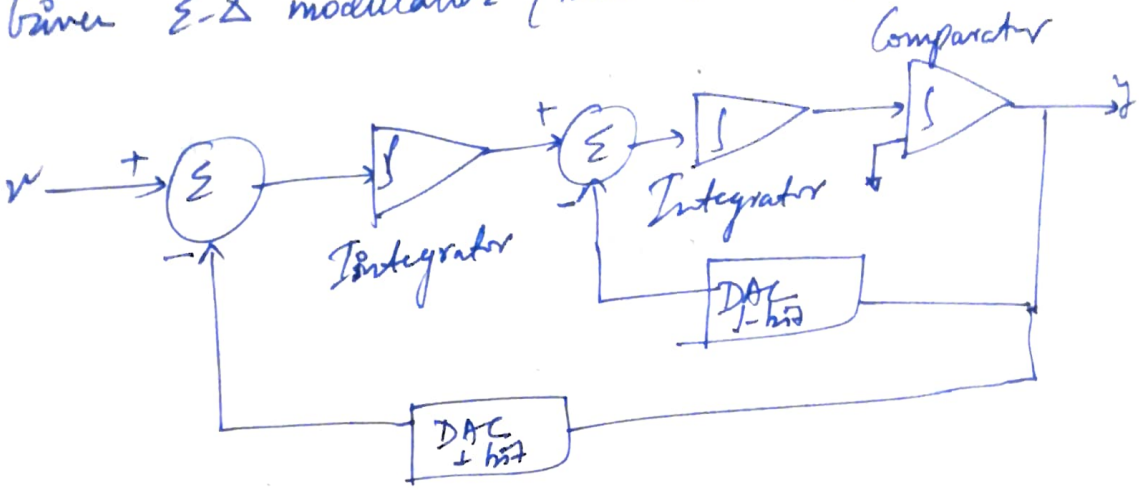
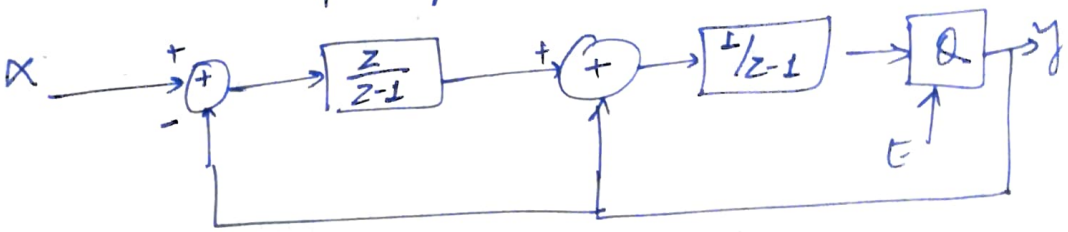
Programmable Embedded Systems

Given $\Sigma$-$\Delta$ modulator (second order):




⇓ Equivalent in z-domain




$Q_E$ is the noise due to quantization.

From here,

$$Y = Q_E + \frac{1}{z-1}\left(-Y + \frac{z}{z-1}(x-y)\right)$$

$$(1-z^{-1})^2 Y = (1-z^{-1})^2 Q_E + z^{-1}\left(x - Y(2-z^{-1})\right)$$

$$\Rightarrow (1+z^{-2}-2z^{-1})Y = (1-z^{-1})^2 Q_E + z^{-1}x - 2z^{-1}Y + z^{-2}Y$$

$$\Rightarrow \boxed{Y = (1-z^{-1})^2 Q_E + z^{-1}x}$$

⇓ Sample domain

$$\boxed{Y[n] = x[n-1] + Q_E[n] + Q_E[n-2] - 2Q_E[n-1]}$$

Time domain

$$y[kT] = x[kT-T] + Q_E[kT] + Q_E[kT-2T] - 2Q_E[ki-T]$$

In $i$th domain,

$$y_i = x_{i-1} + e_i + e_{i-2} - 2e_{i-1}$$