Lab-9 Report

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Q1

(a)

ⓐ $$x[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi} X(\omega)\, e^{j\omega n}\, d\omega \quad [\text{IDTFT}]$$

$$= \frac{1}{2\pi}\int_{-\pi/6}^{\pi/6} e^{-j\omega n_c}\, e^{j\omega n}\, d\omega = \frac{1}{2\pi}\int_{-\pi/6}^{\pi/6} e^{j\omega(n-n_c)}\, d\omega$$

$$= \frac{1}{2\pi}\left[\frac{e^{j\omega(n-n_c)}}{j(n-n_c)}\right]\Bigg|_{-\pi/6}^{\pi/6}$$

$$= \frac{1}{\pi(n-n_c)}\left[\frac{e^{j(\pi/6)(n-n_c)} - e^{-j(\pi/6)(n-n_c)}}{2j}\right]$$

$$= \frac{1}{\pi(n-n_c)}\sin\left(\frac{\pi}{6}(n-n_c)\right)$$

$$= \boxed{\frac{1}{6}\times \operatorname{sinc}\left(\frac{(n-n_c)\pi}{6}\right)}$$

(b)

No, the phase is not linear but has a zig-zag phase.

(d)

Blackman filter gives better result. Rectangular window is seen to have some ripples after the cut-off frequency but the blackman window has dip to -100 dB after the cut-off frequency.

(f)

The given filter is a high-pass filter. It allows high frequency to pass and low frequencies are attenuation.

This can be clearly observed in the magnitude plot.

Q2

(d)

Changing r0 value changes the location of poles of the transfer function, thus eventually affecting the output.

As r0 value increases sharpness of the notch increases thus making it better.

Q3

(d)

Changing the design method to least square from equiripple gives a similar output.

Equiripple filter is a better filter as it has constant and lesser amplitude ripples after cut-off frequency.