Problem 1

Using the impulse invariance method for analog to digital filter conversion, calculate the Chebyshev lowpass digital filter with parameters: passband frequency 20MHz; stopband frequency = 22MHz; passband ripple 0.5dB; stopband (out-of-band) attenuation 70dB; sampling frequency Fs = 60MHz.

a) Plot the impulse response for both analog and digital systems.

b) Plot the magnitude response for analog and digital systems in the frequency domain.

Provide code.

Problem 2

Implement a digital prototype of the analog filter with the transfer function

$$H(s)=\frac{s+2.5}{s^2+2.5s+4}$$

using the Bilinear Transformation. The sample clock frequency is Fs =20Hz.

a) Determine the Linear Difference Equation of the digital filter.

b) Plot impulse and frequency responses for digital and analog filters.

Provide code.

Problem 3

A filter has the transfer function

$$H(z)=3+4z^{-1}+6z^{-2}+8z^{-3}$$

Determine the impulse response of the filter with the modified frequency response

$$F(\omega)=H(\omega-3\pi/4).$$

Problem 4

For a linear system with the transfer function

$$H(z)=\frac{z+1}{z^3+z^2+2z+2}$$

a) Calculate the difference equation relating the input x[n] to the output y[n]

b) Design block diagram realizations (Direct-Form 1 and Direct-Form 2)

c) Plot impulse and frequency responses

Provide code.

Problem 5

Using 10-steps CORDIC algorithm, calculate

a) arctan (1.5)

b) abs (2.2+3.3*j)

Justify the approach. Compare with the actual value. Provide code.