Problem 10.28

Given, $y[n] = (0.95)^n \cos(0.2\pi n + 0.4\pi)$

(a) Plot of $y[n]$ for $0 \le n \le 10$:

Stem Plot of $y(n) = (0.95)^n \cdot \cos(0.2\pi \cdot n + 0.4\pi)$
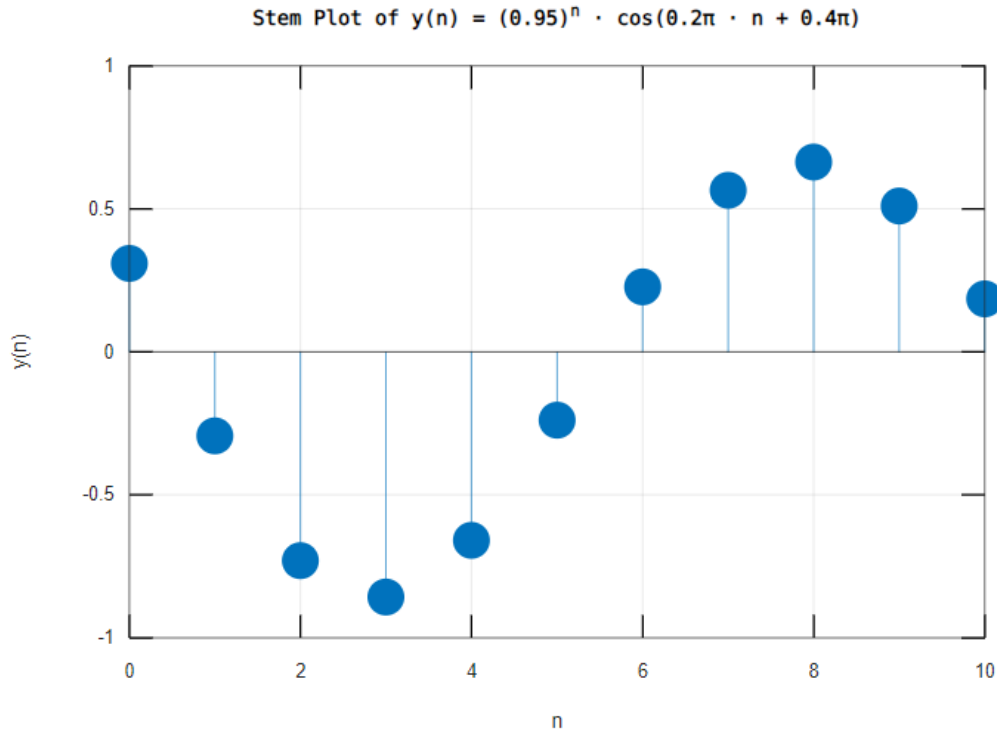
(b) IIR filter that will synthesize $y[n]$ as its impulse response will have an impulse response: $h[n] = (0.95)^n \cos(0.2\pi n + 0.4\pi)u[n]$. Required to find the output for this impulse response.

Taking z-transform of $h[n]$ yields:

$$H(z) = \frac{\frac{1}{2}e^{j0.4\pi}}{1 - 0.95e^{j0.2\pi}z^{-1}} + \frac{\frac{1}{2}e^{-j0.4\pi}}{1 - 0.95e^{-j0.2\pi}z^{-1}}$$

Taking LCM yields:

$$H(z) = \frac{\cos(0.4\pi) - 0.95\cos(0.2\pi)z^{-1}}{1 - 1.9\cos(0.2\pi)z^{-1} + 0.9025z^{-2}} = \frac{0.31 - 0.85z^{-1}}{1 - 1.54z^{-1} + 0.9z^{-2}}$$

Output$(y_1[n])$ in the form of difference equation is:

$$y_1[n] = 0.31x[n] - 0.85x[n-1] + 1.54y_1[n-1] - 0.90y_1[n-2]$$