CHAPTER 11

Design of IIR Filters

Basic Problems

20. (a) Solution:

$$h_{\mathrm{zp}}[n] = h[n] + h[-n]$$

(b) Solution:
The frequency response is:

$$H_{\mathrm{zp}}\left(\mathrm{e}^{\mathrm{j}\omega}\right) = 2\mathrm{Re}[H\left(\mathrm{e}^{\mathrm{j}\omega}\right)]$$

(c) tba.

21. (a) See plot below.

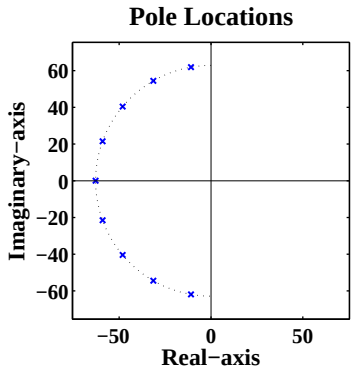

FIGURE 11.1: Pole locations of $H_{\mathrm{c}}(s)$

(b) See plot below.

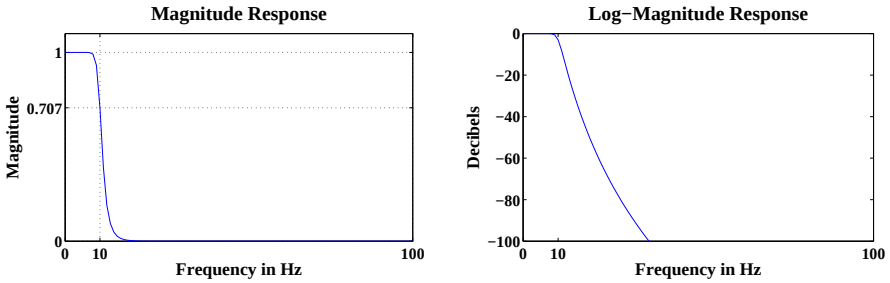

FIGURE 11.2: Magnitude and log-magnitude responses over $[0, 100]$ Hz range.

(c) Solution:
The frequencies are 14.68, 16.68, and 18.96 rad/s at which the attenuation is 30 dB, 40 dB, and 50 dB.

22. See plot below.

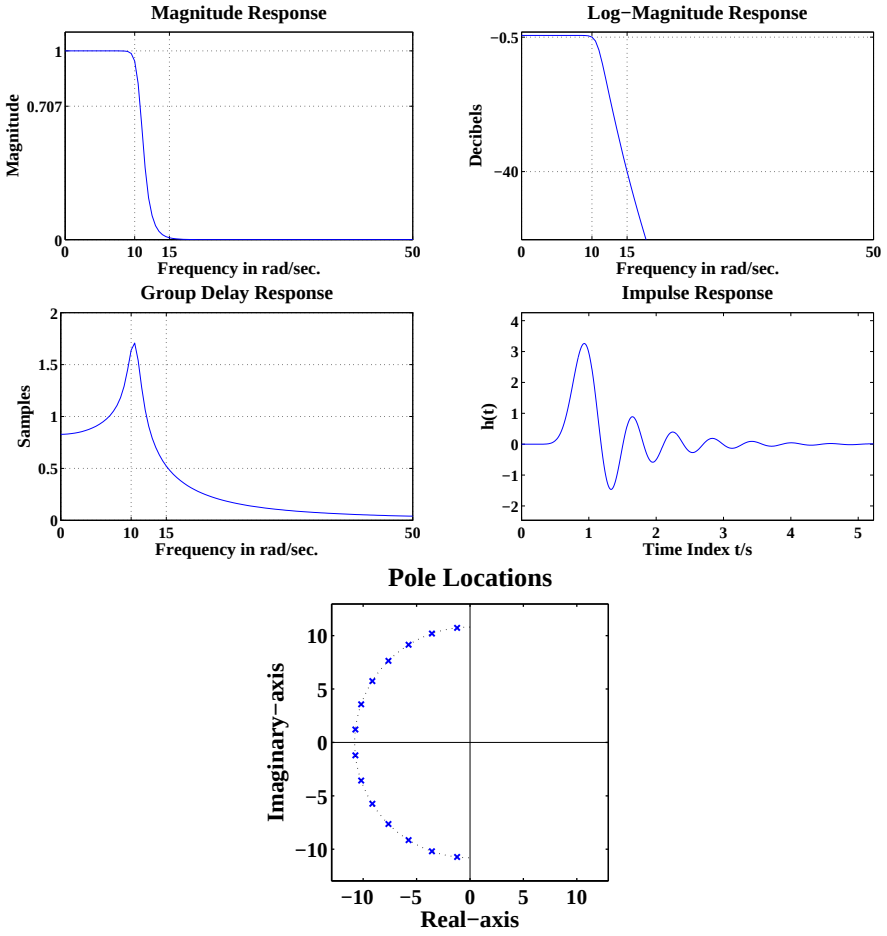

FIGURE 11.3: Plots of the magnitude, log-magnitude, group-delay, and impulse responses and pole-zero plot of the filter.

23. See plot below.

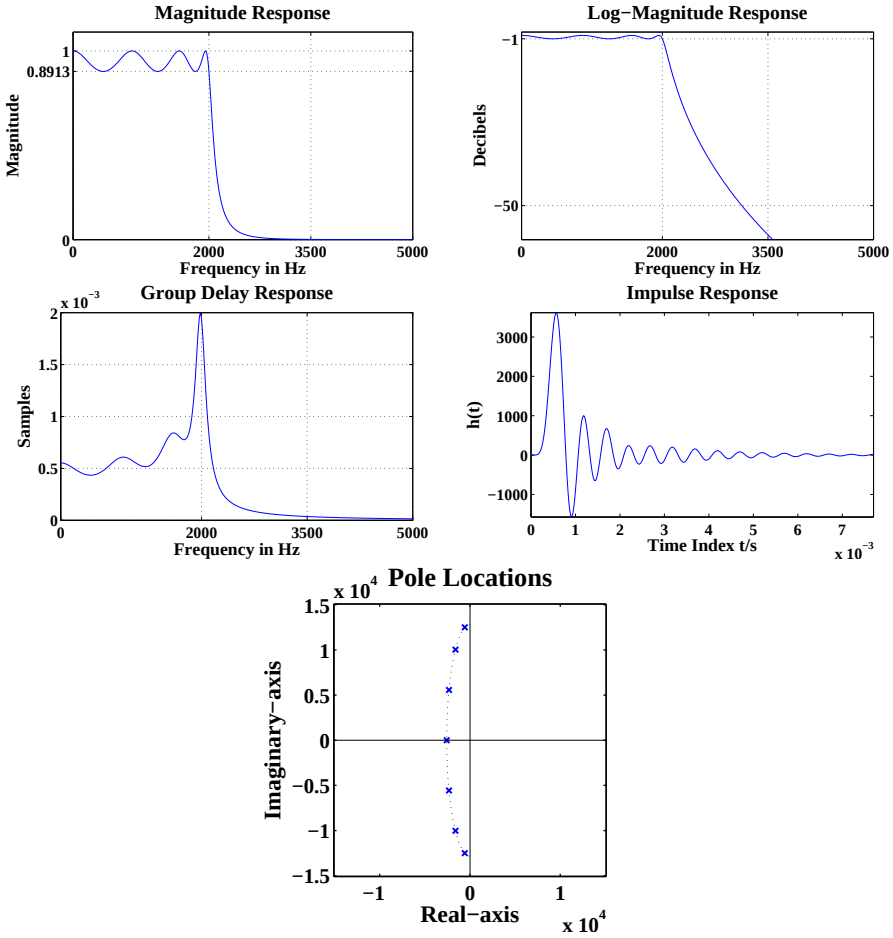

FIGURE 11.4: Plots of the magnitude, log-magnitude, group-delay, and impulse responses and pole-zero plot of the filter.

24. tba

25. See plot below.

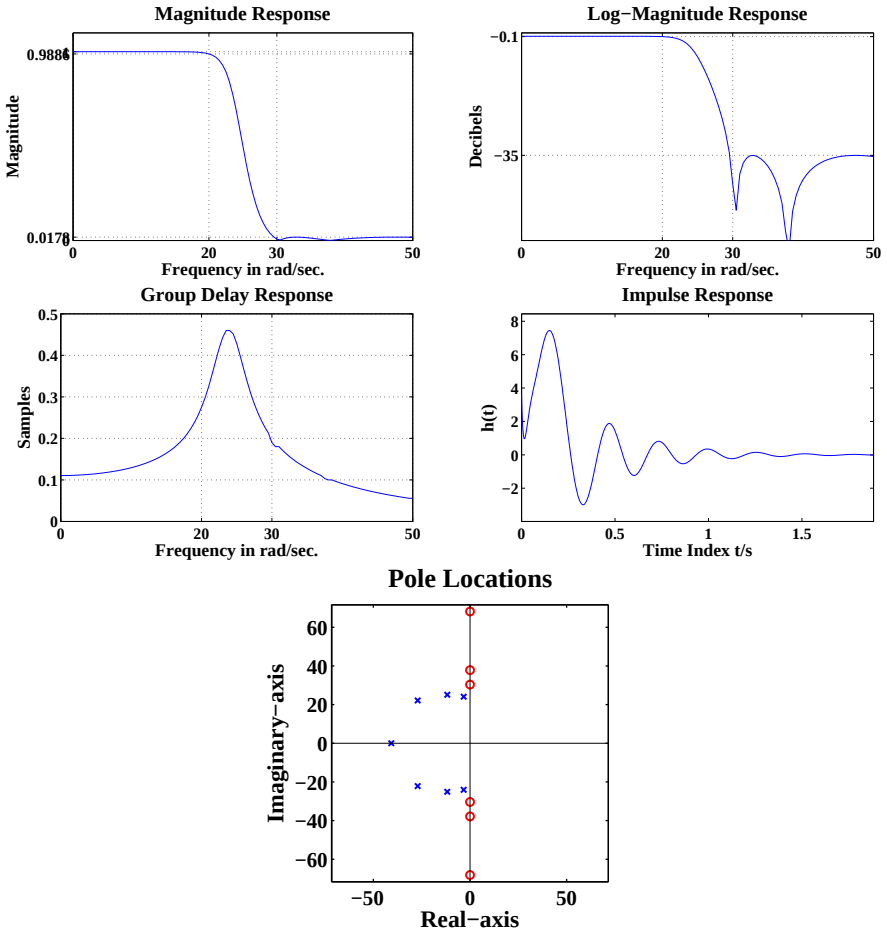

FIGURE 11.5: Plots of the magnitude, log-magnitude, group-delay, and impulse responses and pole-zero plot of the filter.

26. See plot below.

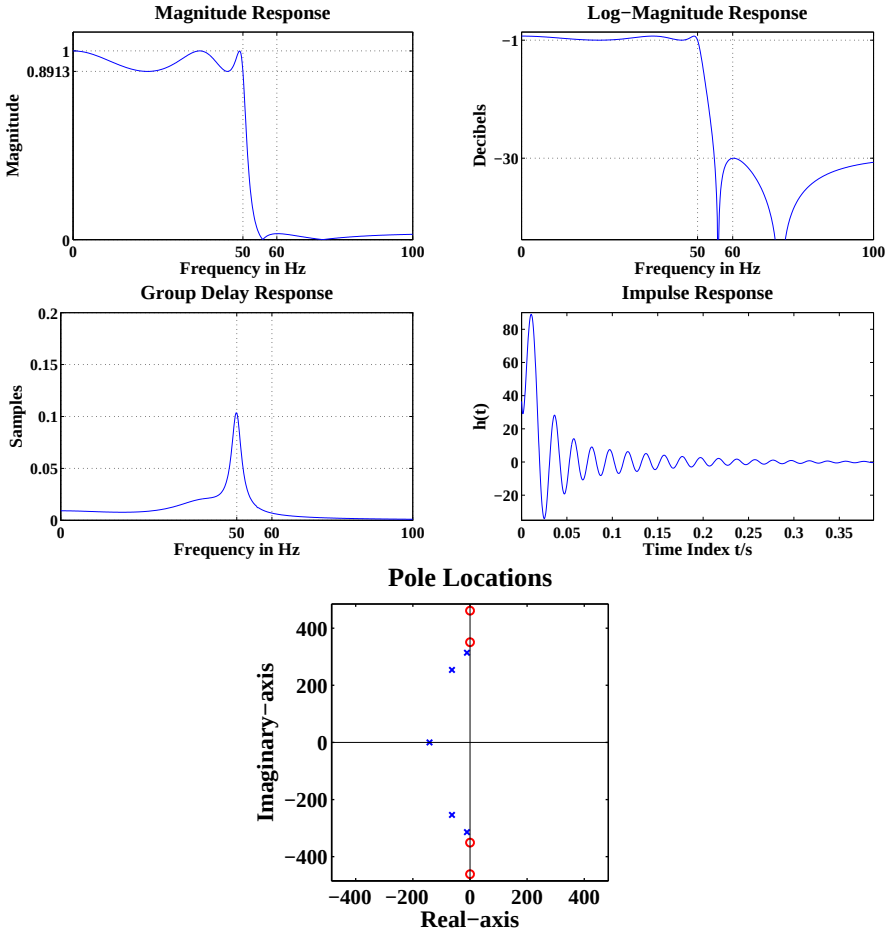

FIGURE 11.6: Plots of the magnitude, log-magnitude, group-delay, and impulse responses and pole-zero plot of the filter.

27. See plot below.

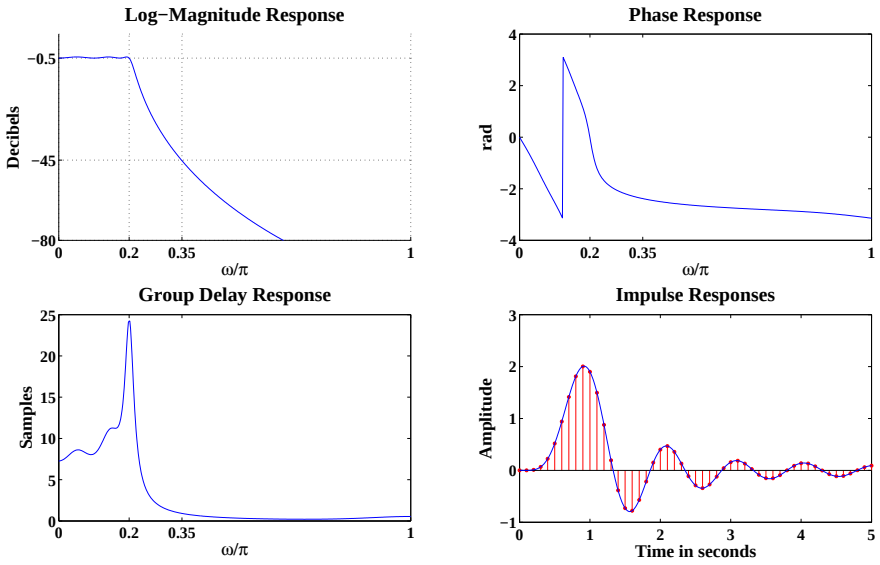

FIGURE 11.7: Plots of log-magnitude, phase, group, and impulse responses.

28. See plot below.

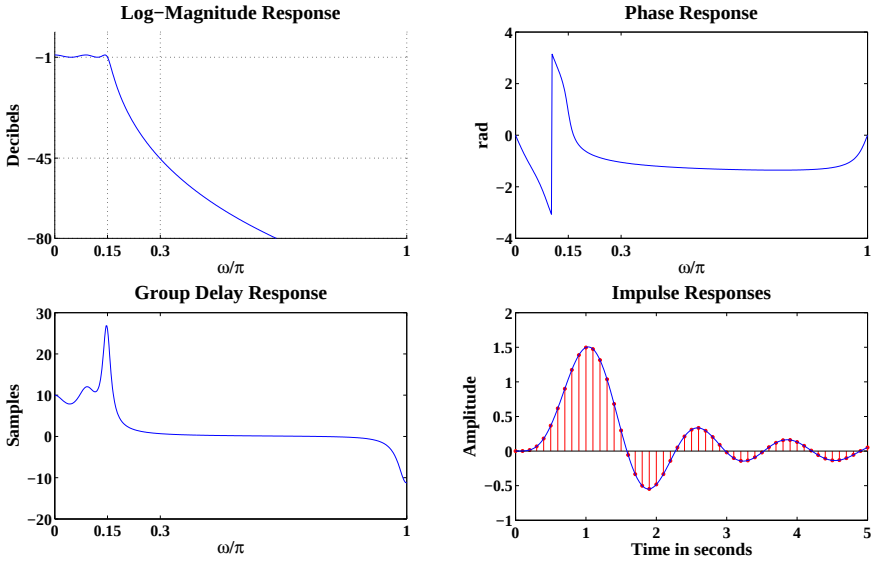

FIGURE 11.8: Plots of log-magnitude, phase, group, and impulse responses.

29. (a) See plot below.

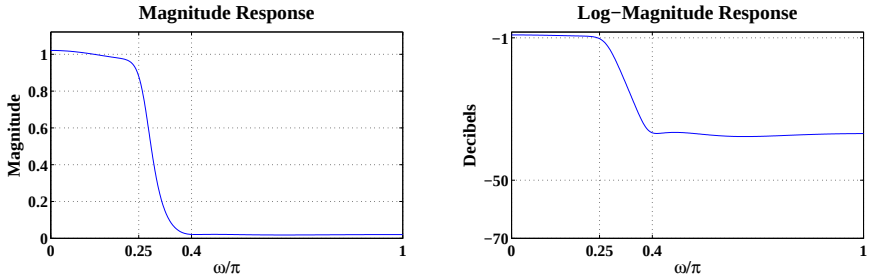

FIGURE 11.9: Plot the magnitude and log-magnitude responses when $As = 50$ dB.

(b) See plot below.

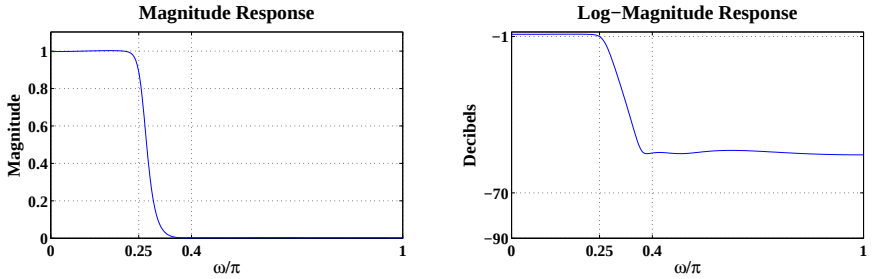

FIGURE 11.10: Plot the magnitude and log-magnitude responses when $As = 70$ dB.

30. See plot below.

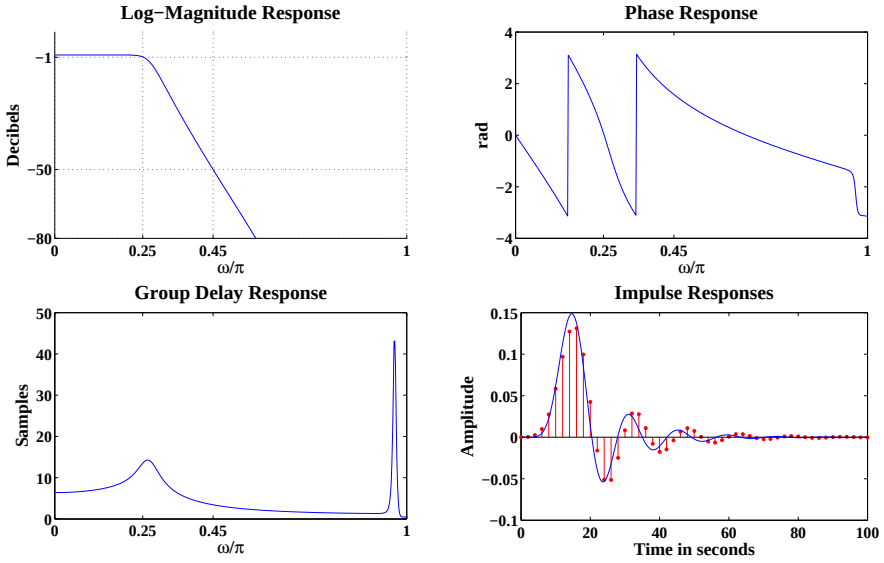

FIGURE 11.11: Plots of log-magnitude, phase, group, and impulse responses.

31. See plot below.

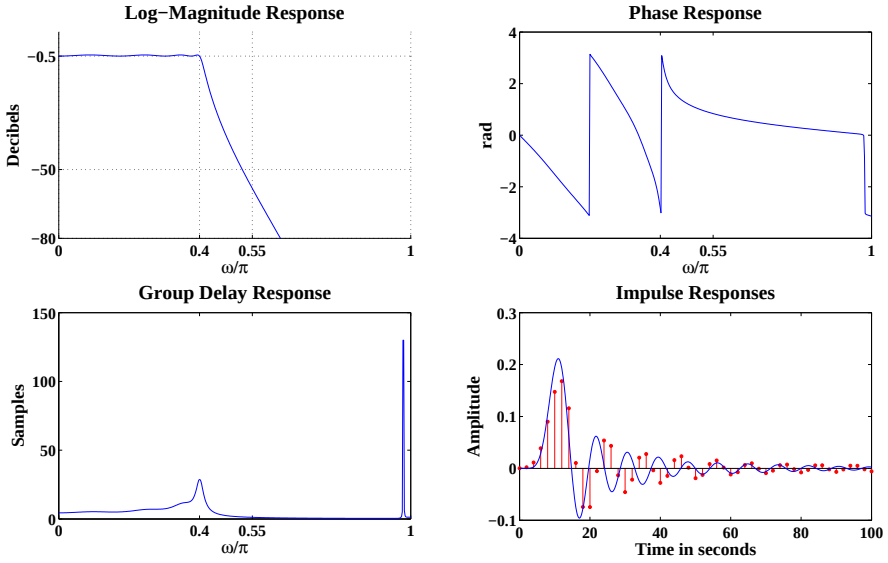

FIGURE 11.12: Plots of log-magnitude, phase, group, and impulse responses.

32. See plot below.

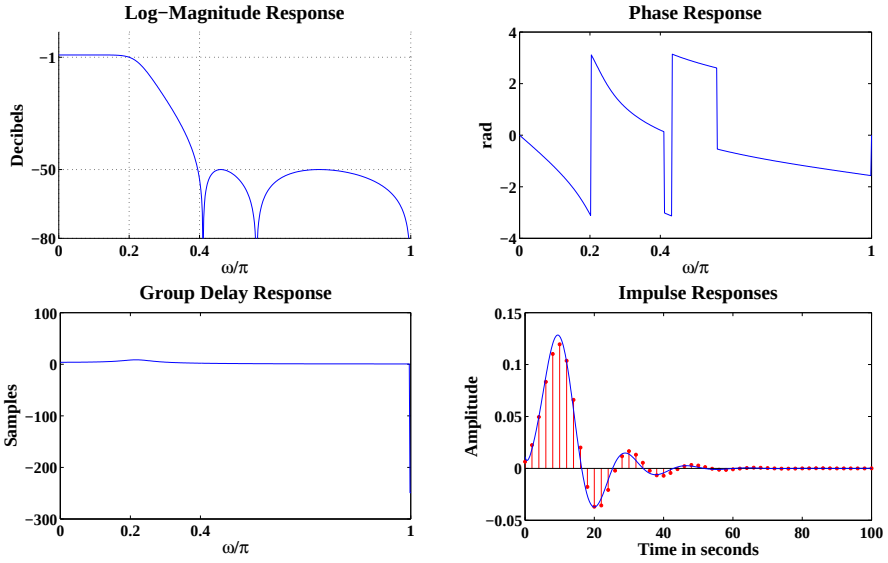

FIGURE 11.13: Plots of log-magnitude, phase, group, and impulse responses.

33. See plot below.

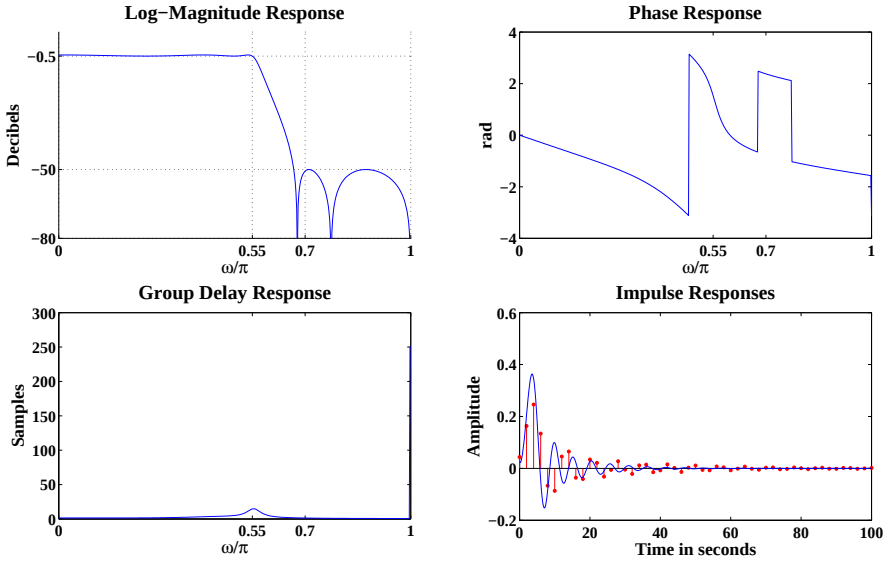

FIGURE 11.14: Plots of log-magnitude, phase, group, and impulse responses.

34. (a) See plot below.

(b) See plot below.

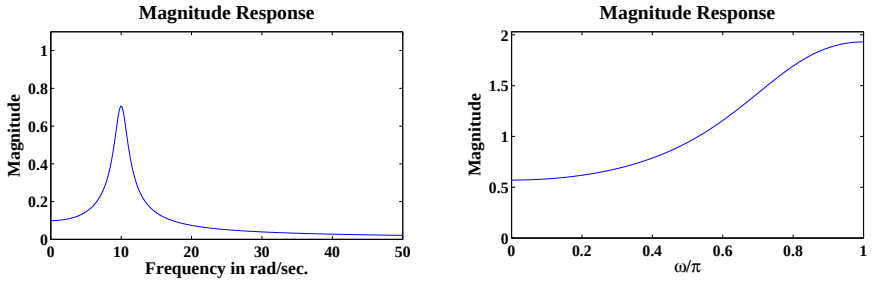

FIGURE 11.15: Plots of the magnitude of the frequency responses of $H_{\mathrm{c}(s)}$ and $H(z)$.

(c) See plot below.

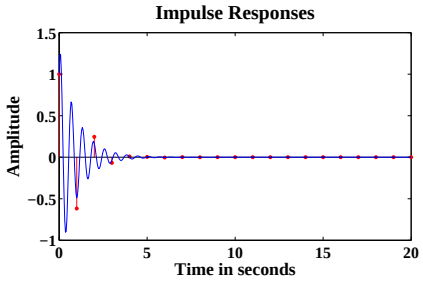

FIGURE 11.16: Impulse responses $h_{\mathrm{c}}(t)$ and $h[n]$.

35. (a) See plot below.

(b) See plot below.

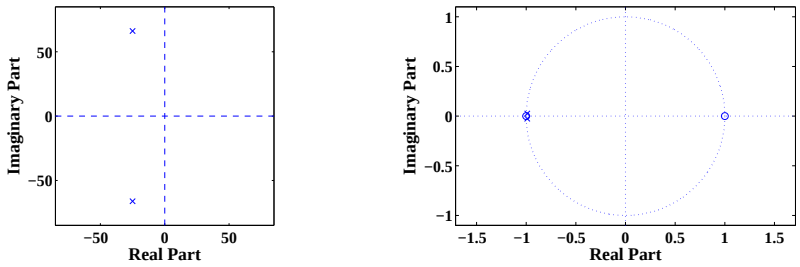

FIGURE 11.17: Plots of pole and zero locations for the analog bandpass filter and for the digital filter with $T_{\mathrm{d}} = 2$.

(c) See plot below.

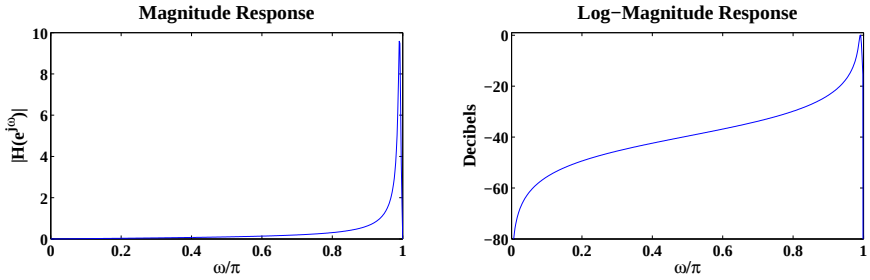

FIGURE 11.18: Plots of the magnitude response of the digital filter.

36.

37. tba.

38. See plot below.

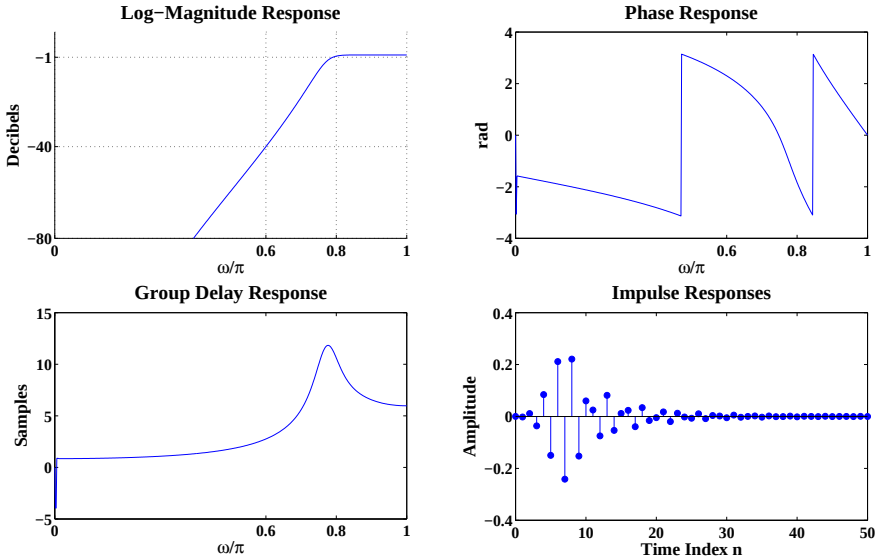

FIGURE 11.19: Plots of log-magnitude, phase, group, and impulse responses.

39. See plot below.

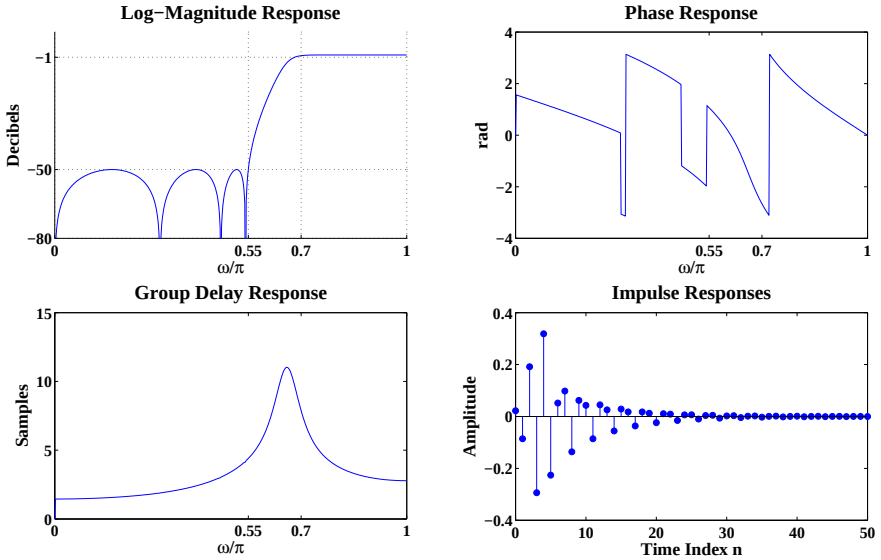

FIGURE 11.20: Plots of log-magnitude, phase, group, and impulse responses.

40. See plot below.

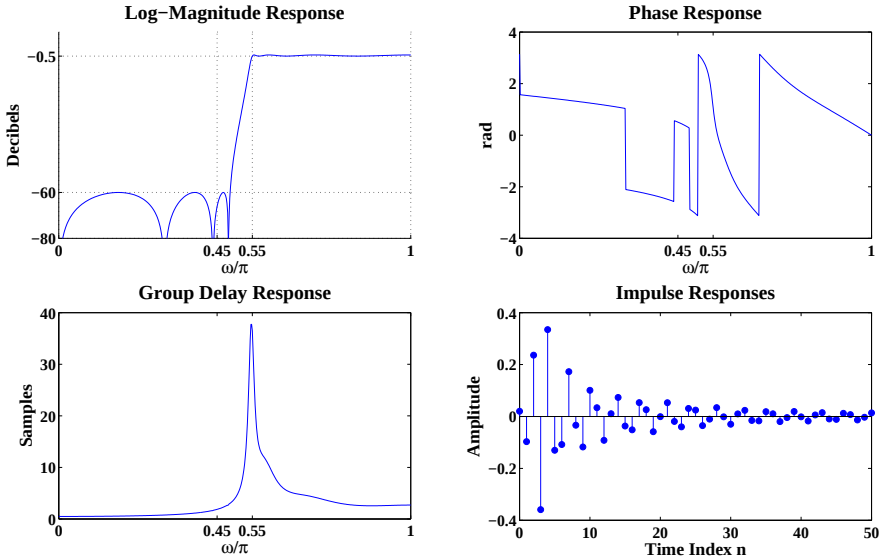

FIGURE 11.21: Plots of log-magnitude, phase, group, and impulse responses.

41. See plot below.

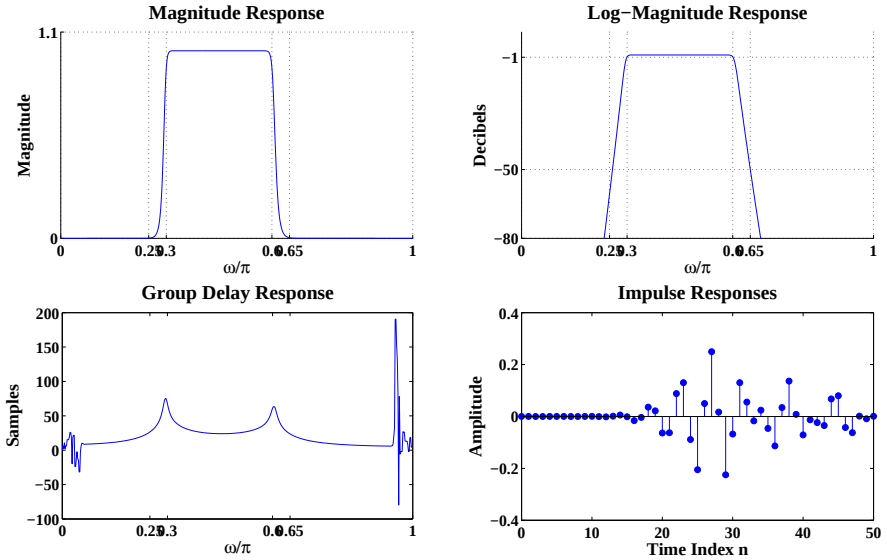

FIGURE 11.22: Plots of the magnitude, log-magnitude, group-delay, and impulse responses..

42. See plot below.

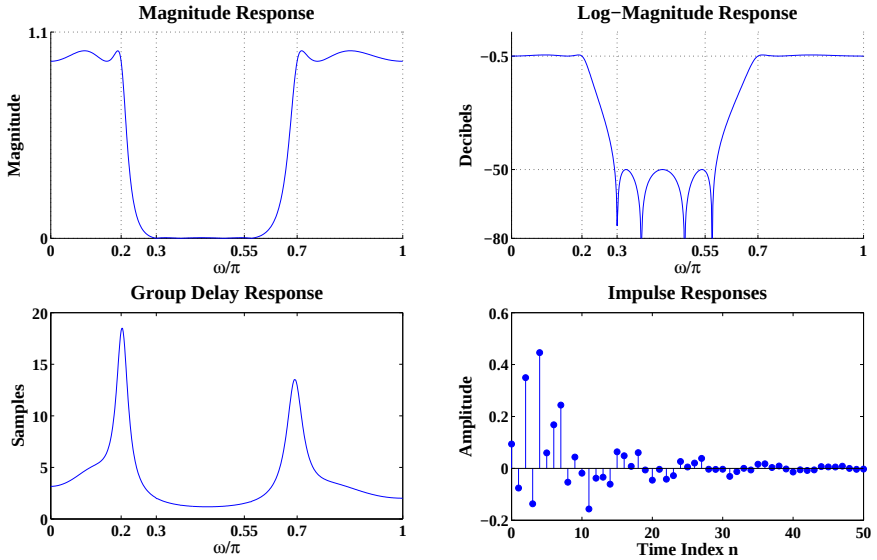

FIGURE 11.23: Plots of the magnitude, log-magnitude, group-delay, and impulse responses..

43. See plot below.

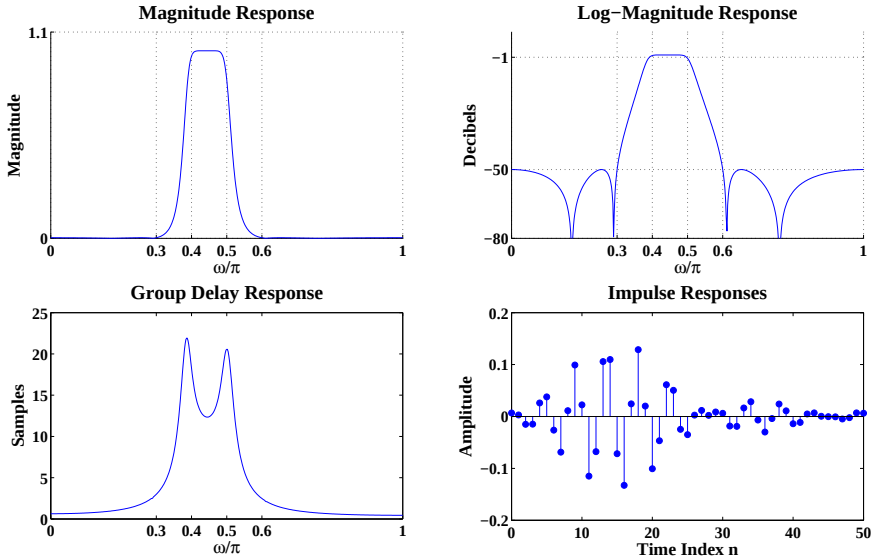

FIGURE 11.24: Plots of the magnitude, log-magnitude, group-delay, and impulse responses..

44. See plot below.

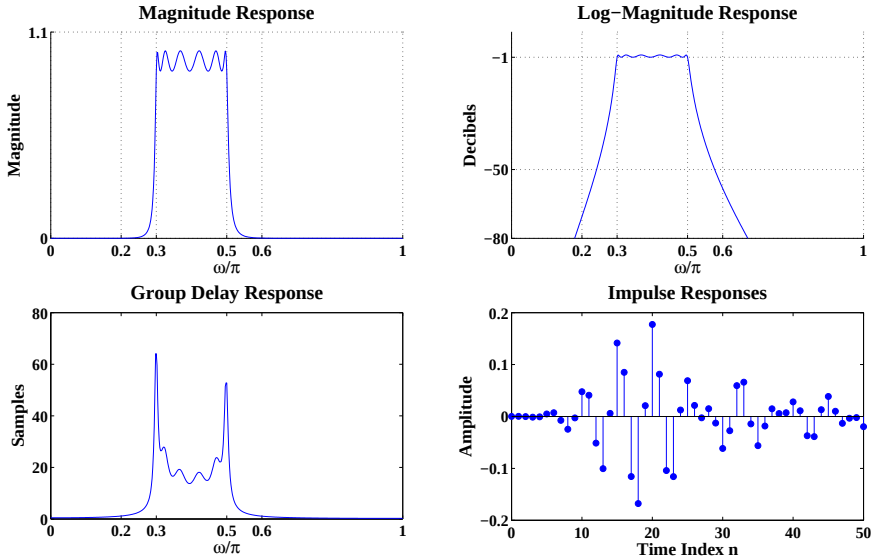

FIGURE 11.25: Plots of the magnitude, log-magnitude, group-delay, and impulse responses..

45. See plot below.

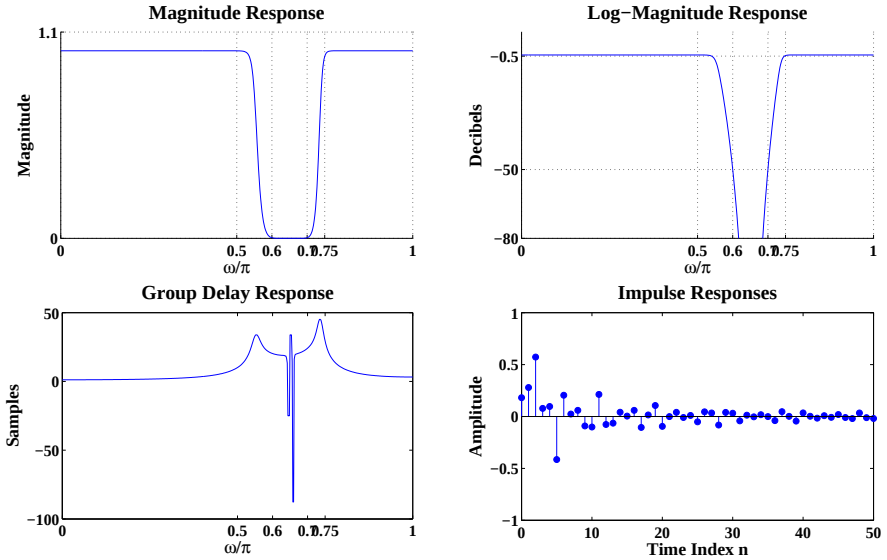

FIGURE 11.26: Plots of the magnitude, log-magnitude, group-delay, and impulse responses..