% ex12\_main.m

clear; close all;

% Parameters

M = 20; % Filter order

wc = 1; % Cutoff frequency in radians

n = 0:M; % Sample index

% FIR Low-Pass Filter formula

h\_LP = sin(wc \* (n - M/2)) ./ (pi \* (n - M/2));

h\_LP(n == M/2) = wc / pi; % Handle special case

% Frequency response

H\_LP = fft(h\_LP, 1024);

w = linspace(-pi, pi, 1024);

% Plot impulse response

figure;

stem(n, h\_LP, 'filled'); grid on;

title(sprintf('Impulse Response h\_{LP}(n), M = %d', M));

xlabel('n'); ylabel('h\_{LP}(n)');

saveas(gcf, 'figures/hLP\_M20.png');

% Plot magnitude of frequency response

figure;

plot(w/pi, abs(fftshift(H\_LP)), 'LineWidth', 1.2); grid on;

title(sprintf('Magnitude Response |H\_{LP}(e^{jω})|, M = %d', M));

xlabel('ω/π'); ylabel('|H\_{LP}|');

% Repeat for M = 64

M = 64; % Change filter order

n = 0:M; % Sample index

% FIR Low-Pass Filter formula

h\_LP = sin(wc \* (n - M/2)) ./ (pi \* (n - M/2));

h\_LP(n == M/2) = wc / pi; % Handle special case

% Frequency response

H\_LP = fft(h\_LP, 1024);

w = linspace(-pi, pi, 1024);

% Plot impulse response

figure;

stem(n, h\_LP, 'filled'); grid on;

title(sprintf('Impulse Response h\_{LP}(n), M = %d', M));

xlabel('n'); ylabel('h\_{LP}(n)');

saveas(gcf, 'figures/hLP\_M64.png');

% Plot magnitude of frequency response

figure;

plot(w/pi, abs(fftshift(H\_LP)), 'LineWidth', 1.2); grid on;

title(sprintf('Magnitude Response |H\_{LP}(e^{jω})|, M = %d', M));

xlabel('ω/π'); ylabel('|H\_{LP}|');

% Compare magnitude responses

figure;

hold on;

plot(w/pi, abs(fftshift(H\_LP)), 'LineWidth', 1.2);

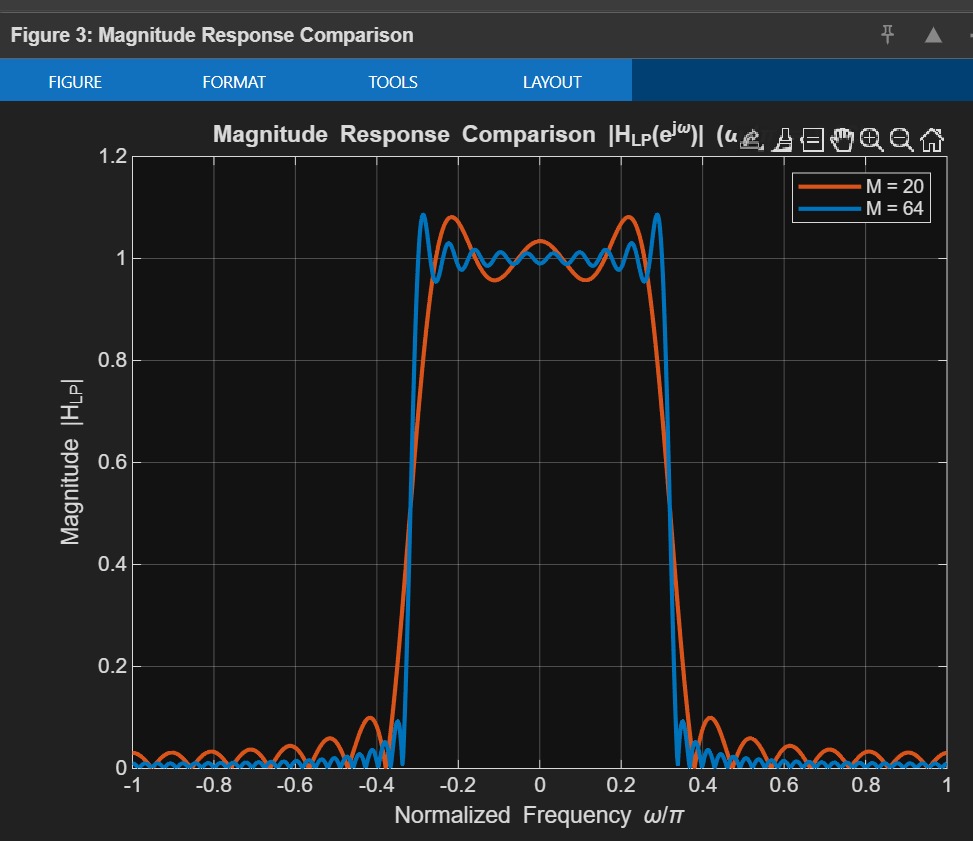
legend('M = 20', 'M = 64');

title('Comparison of Magnitude Responses');

xlabel('ω/π'); ylabel('|H\_{LP}|');

grid on;

saveas(gcf, 'figures/HLP\_compare.png');

A screenshot of a computer

Description automatically generated