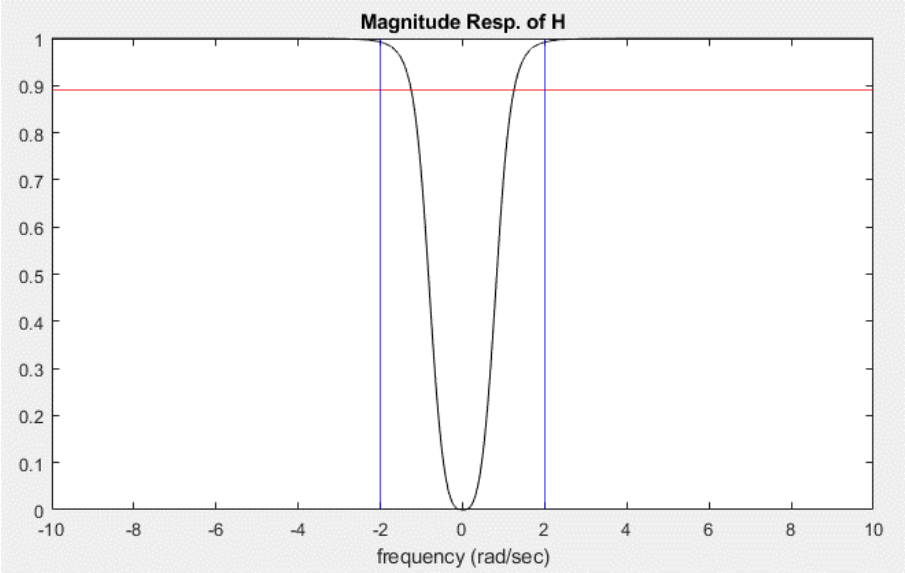
2.6-2 (b,c))

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

First, we need a w_0 value. Let's plot the prototype high-pass transfer function.



It looks like w_0 is around 2 rad/sec. Let's use a cost function in MATLAB to figure out the exact frequency

Editor - C:\Users\thomas.smallarz\Documents\MATLAB\HW2\cost.m

cost.m | C2_6_2b.m

```
function [J] = cost(z)
    ideal = 0.8913;
    s = j*z;
    guess = abs(s^3 / (s^3 + 2*s^2 + 2*s + 1));

    e = abs(ideal) - abs(guess);
    J = e^2;
end

```

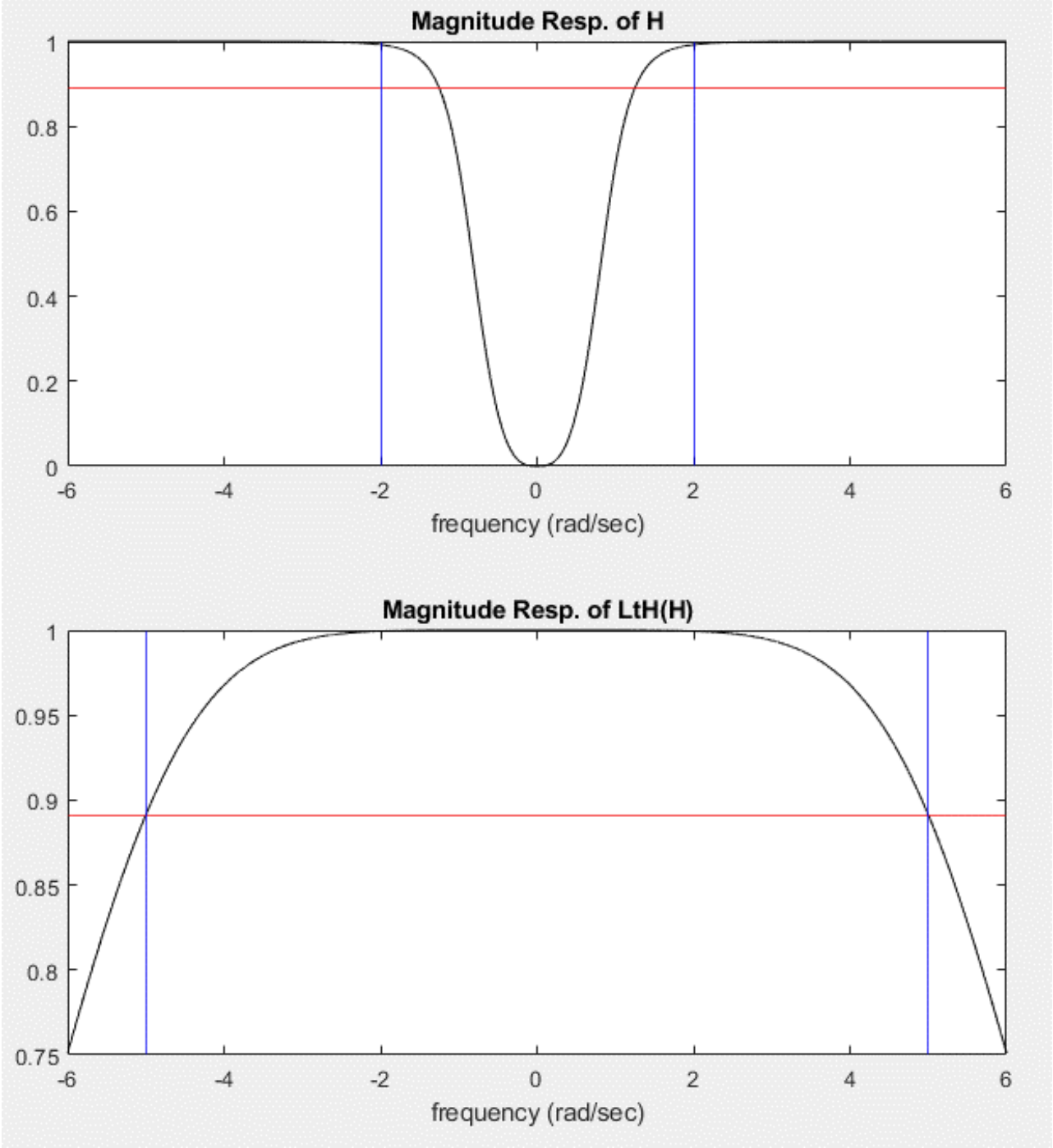
Command Window

```
>> [w,error] = fminsearch('cost',2)

w =

    1.2527


error =

   4.1112e-10
```

b) Low-pass to High-pass transformation

$$s \rightarrow \frac{\omega_0\omega_1}{s} \qquad \omega \rightarrow \frac{\omega_0\omega_1}{-\omega} \; where \; \omega_0\omega_1 = 1.2527 * 5 = 6.2637$$

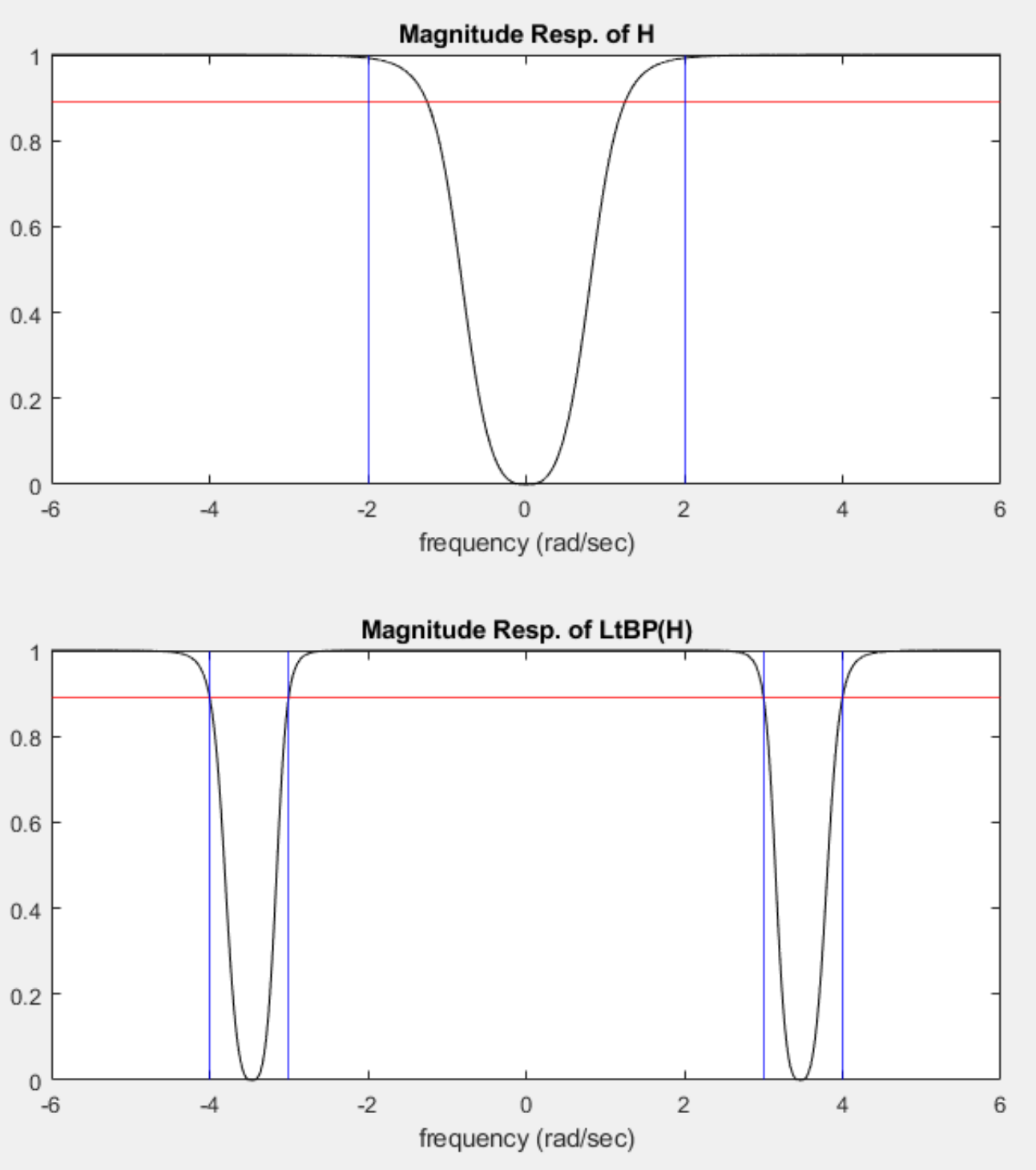
In MATLAB,



c) Lowpass-to-bandpass transformation with $\omega_1 = 3\frac{rad}{sec} \quad and \quad \omega_2 = 4\frac{rad}{sec}$

$$s \to \omega_0 \frac{s^2 + \omega_1\omega_2}{s(\omega_2 - \omega_1)}$$

In MATLAB,



Thomas Smallarz ECE444 Homework 2

MATLAB FOR 2.6-2 (b,c)

Editor - C:\Users\thomas.smallarz\Documents\MATLAB\HW2\C2_6_2b.m

C2_6_2b.m

```
H = @(s) s.^3 ./ (s.^3 + 2.*s.^2 + 2.*s + 1);

w = -6:0.001:6;
s_a = j.*w;
s_b = 6.2637 ./ (s_a);
s_c = 1.2527 .* (s_a.^2 + 12) ./ (s_a);

subplot(221); plot(w,abs(H(s_a)),'k'); yline(0.8913,'r'); xline(2,'b'); xline(-2,'b');
title("Magnitude Resp. of H"); xlabel("frequency (rad/sec)");

subplot(223); plot(w,abs(H(s_b)),'k'); yline(0.8913,'r'); xline(5,'b'); xline(-5,'b');
title("Magnitude Resp. of LtH(H)"); xlabel("frequency (rad/sec)");

subplot(222); plot(w,abs(H(s_c)),'k'); yline(0.8913,'r');
xline(3,'b'); xline(4,'b'); xline(-3,'b'); xline(-4,'b');
title("Magnitude Resp. of LtBP(H)"); xlabel("frequency (rad/sec)");

```

Editor - C:\Users\thomas.smallarz\Documents\MATLAB\HW2\cost.m

C2_6_2b.m cost.m

```
function [J] = cost(z)
    ideal = 0.8913;
    s = j*z;
    guess = abs(s^3 / (s^3 + 2*s^2 + 2*s + 1));

    e = abs(ideal) - abs(guess);
    J = e^2;
end

```