## 8.14 End of Chapter Problems

### EOCP 8.1

Draw the poles of

$$H(s) = \frac{1}{1+(s/jw_s)^{2N}}$$

for a third-order lowpass Butterworth filter after replacing $s$ by $jw$.

### EOCP 8.2

Consider a series RLC circuit where the output voltage $y(t)$ is taken across the resistor and the input is the voltage $x(t)$.

1. Find the transfer function of this filter.
2. What is this type of filter?

### EOCP 8.3

An elliptic bandstop filter is to be designed. It should fulfill the following specifications:

| | |
|---|---|
| $1 >= \|H(jw)\|^2 >= 0.95$ | $w <= 1200$ and $w >= 1800$ |
| $\|H(jw)\|^2 <= 0.02$ | $800 >= w >= 2200$ |

1. Estimate the order and the cut-off frequencies.
2. Find the transfer function of the filter.

### EOCP 8.4

Plot the magnitude and phase responses of Butterworth, Chebyshev Type I, Chebyshev Type II, elliptic, and Bessel LP filters. Let the order be 5 and the cut-off frequency be 1. Assume $R_p$ = 3 dB and $R_s$ = 60 dB. Comment on the phase response of Bessel filter compared with others.

### EOCP 8.5

Design a bandstop filter that has a bandwidth β of 1000 rad/sec that can reject the component sin(1414$t$) from the following signal

$$x(t) = \sin(500t) + \sin(1414t) + \cos(2500t)$$

### *EOCP 8.6*

Consider the following transfer function

$$H(s) = \frac{as^2 + bs + c}{s^2 + ds + e}$$

Design by finding the values of $a$, $b$, $c$, $d$ and $e$ the filters in the table below. (Hint: The transfer function above is for a Butterworth filter.)

| Type | $w_n$ | a | b | c | d | e |
|---|---|---|---|---|---|---|
| LP | 1000 | | | | | |
| HP | 1000 | | | | | |
| BP | 1000, 2000 | | | | | |
| BS | 1000, 2000 | | | | | |

### *EOCP 8.7*

A lowpass filter has a desired peak passband ripple of 0.2 dB, and a minimum stopband attenuation of 40 dB; what are the values of $\varepsilon$ and $\delta$?

### *EOCP 8.8*

Find and graph the frequency response of the transfer functions given by

$$H(s) = \frac{0.2s^2 + 1}{s^2 + 0.1s + 1}$$

$$H(s) = \frac{s^2}{s^2 + 0.1s + 1}$$

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

$$H(s) = \frac{s}{s^2 + 0.1s + 1}$$

What type of filters are these systems?