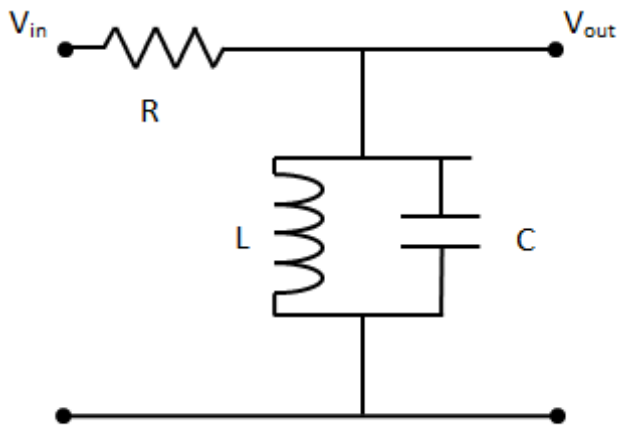
Bandpass Filter Design



The product L C controls the bandpass frequency while R C controls how narrow the passing band is. To build a bandpass filter tuned to 1 rad/s, set L = C = 1 and use R to tune the filter band.

Use functions from DynamicSystems package

```
DF := DynamicSystems
```

Response of a bandpass filter

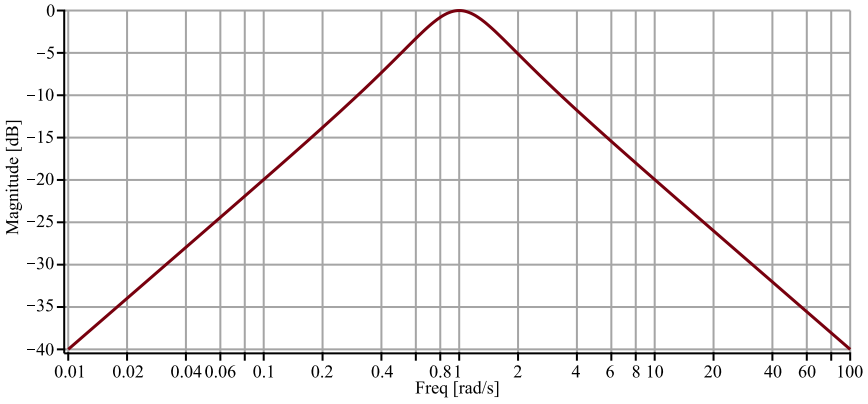
$$G := \frac{\frac{s}{R \cdot C}}{s^2 + \frac{s}{R \cdot C} + \frac{1}{L \cdot C}}$$

Transfer function object

```
TF := DF:-TransferFunction(G)
```

Magnitude plot

```
DF:-MagnitudePlot(TF, parameters = [R = 1, L = 1, C = 1]) =
```

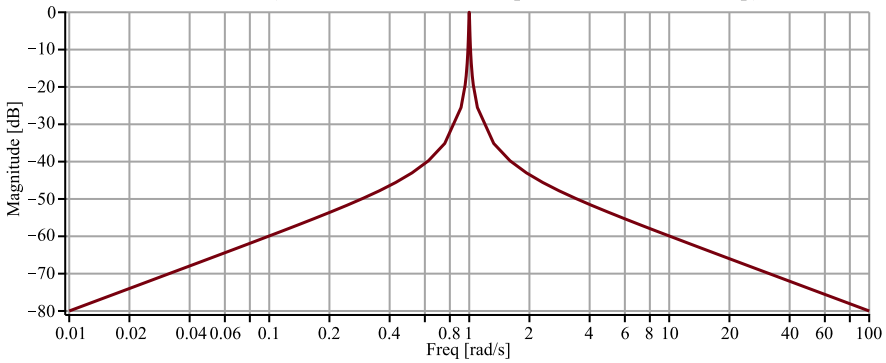


As expected, the RLC fliter has maximum gain at the frequency 1 rad/s. Hoever the attenuation is only -10 dB awayfrom this frequency.

Get a narrower passing band by increasing R

$R_f := 100$

DF:-MagnitudePlot(TF, parameters = [R = R_f, L = 1, C = 1]) =



The resistor value R = 20 gives a filter narrowly tuned around the target frequency of 1 rad/s

We can confirm the attentuation properties of the circuit by simulating how this filter transfsforms sine waves.

Frequencies $f_1 := 0.9$ $f_2 := 1$

p1 := DF:-ResponsePlot(TF, sin(f_1·t), duration = 100, parameters = [R = R_f, L = 1, C = 1], color = "DarkRed", thickness = 1, *Legend* = sprintf("%.2f rad/s", f_1))

p2 := DF:-ResponsePlot(TF, sin(f_2·t), duration = 100, parameters = [R = R_f, L = 1, C = 1], color = "Nautical Light Blue", thickness = 1, legend = sprintf("%.2f rad/s", f_2))

plots:-display(p1, p2, axes = box) =