Fourier Transform of sine - Gaussian

Define Functions

In[2]:= **sineGaussian =** $\frac{A}{\sqrt{2\pi}\,\sigma} e^{\frac{-(t-f_c)^2}{2\sigma^2}} \mathrm{Sin}[2\pi f_c t]$

Out[2]= $\frac{A\, e^{-\frac{(t-f_c)^2}{2\sigma^2}} \mathrm{Sin}[2\pi t f_c]}{\sqrt{2\pi}\,\sigma}$

In[3]:= **FT = Abs**$\left[\frac{\sqrt{2}}{\sqrt{T}} \int_{-T}^{T} \left(\text{sineGaussian}\, e^{2\pi f i t}\right) dt\right]$

Out[3]= $$\frac{1}{2\sqrt{2}} e^{-2\pi\,\mathrm{Re}\left[f^2 \pi \sigma^2 + f(-i + 2\pi\sigma^2) f_c + \pi\sigma^2 f_c^2\right]} \mathrm{Abs}\Bigg[\frac{1}{\sqrt{T}} A \left(e^{2\pi(4 f \pi \sigma^2 - i f_c) f_c} \left(\mathrm{Erf}\left[\frac{T + 2 i \pi \sigma^2 (f - f_c) + f_c}{\sqrt{2}\,\sigma}\right] + \mathrm{Erf}\left[\frac{T - 2 i f \pi \sigma^2 + (-1 + 2 i \pi \sigma^2) f_c}{\sqrt{2}\,\sigma}\right]\right) - e^{2 i \pi f_c^2} \left(\mathrm{Erf}\left[\frac{T - f_c - 2 i \pi \sigma^2 (f + f_c)}{\sqrt{2}\,\sigma}\right] + \mathrm{Erf}\left[\frac{T + f_c + 2 i \pi \sigma^2 (f + f_c)}{\sqrt{2}\,\sigma}\right]\right)\right)\Bigg]$$

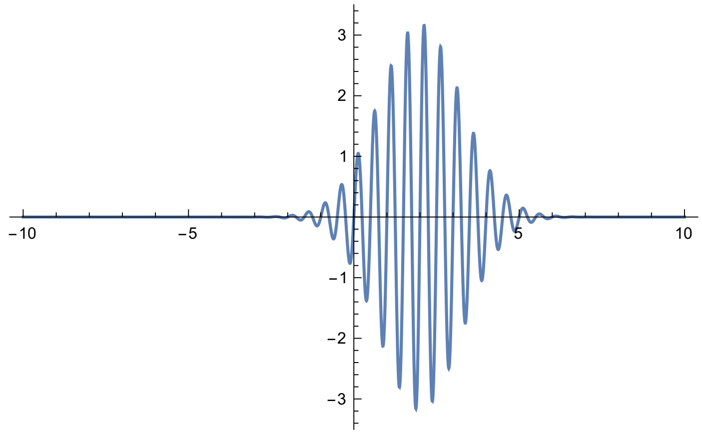
Define constants

In[4]:= **T = 10; f_c = 2; Q = 10; σ =** $\frac{2\pi f_c}{Q}$**; A = 10;**

Plot time-series

In[5]:=
```
Plot[Evaluate[sineGaussian /. {A → A, fc → fc, σ → σ}], {t, -T, T}, PlotRange → All]
```

Out[5]=



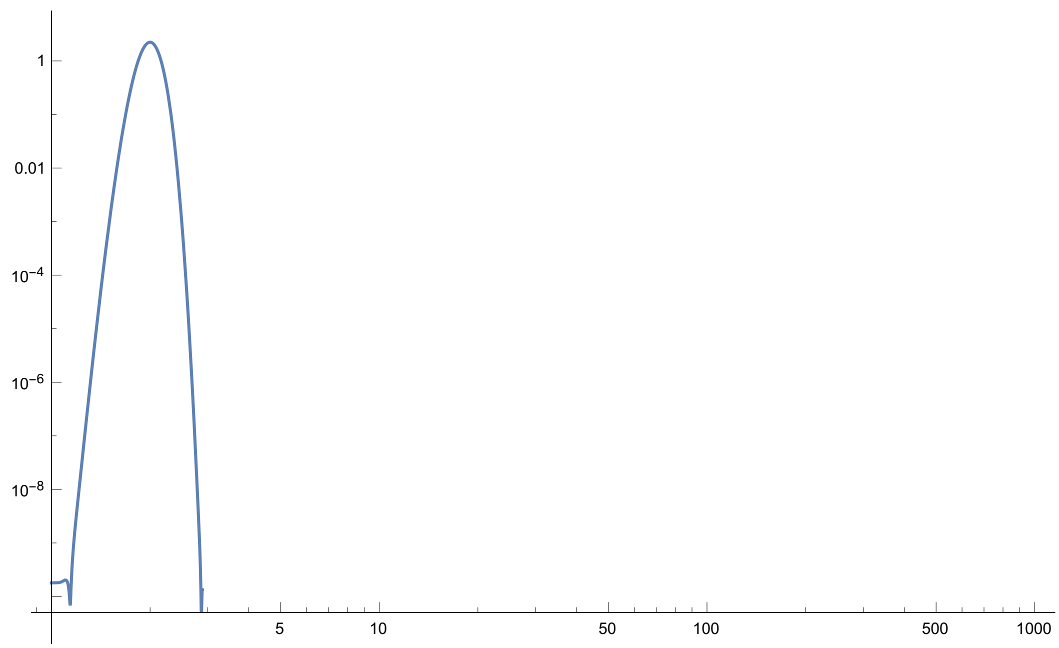
~~If I copy the output of typing FT[f] and turn it into a new function, and plot the new function, it is significantly faster than just plotting FT[g] - this takes much longer.~~

In[ ]:=

Plot Fourier Transform

In[6]:=
```
LogLogPlot[Evaluate[FT /. {T → T, A → A, fc → fc, σ → σ}], {f, 1, 1000}, PlotRange → Full]
```

Out[6]=



In[10]:=
```
Evaluate[FT /. {T → T, A → A, f_c → f_c, σ → σ, f → 3.0}]
```

General: Exp[−779.273] is too small to represent as a normalized machine number; precision may be lost.

Out[10]=
```
0.
```