Driven Oscillators: Summary

- Natural frequency with damping is slightly different than without damping.
- Starting from rest, the system tries to oscillate at the natural frequency.
- In time, it oscillates at the driving frequency.
- The resonant frequency is close to the natural frequency.
- Below resonance, the oscillation is in phase with the driving force. Above resonance, it is 180° out of phase.
- The energy in an oscillation vs frequency is proportional to the response function, $|A|^2$.
- The FWHM of the response function is about $2\beta$.
- The response function at a given frequency is proportional to the Fourier transform of the undriven damped oscillation at that frequency.

Q-Factor

$Q$ is defined in a driven oscillator as:

$$Q = \frac{\text{resonant } \omega}{\text{FWHM}} = \frac{\omega_0}{2\beta}$$

This is equivalent to:

$$Q = \frac{\pi \times \text{decay constant}}{\text{Period}}$$

Q-Factor

The $Q$ of a damped oscillator is

$$Q = \frac{2\pi \times E}{\text{Energy lost in one cycle}}$$