Lecture 6, Sep 20, 2022

Average Power of a Forced Oscillator

- When average power is potted against $\dfrac{\omega}{\omega_0}$, max power occurs near resonance
  - From the curve of average power vs frequency, we can figure out damping
  - Full width at half height when plotted against ω is γ
- The shape of this curve gets more asymmetric with more damping (higher γ)
- Full width at half height is $\dfrac{\gamma}{\omega_0} = \dfrac{1}{Q}$
  - The smaller the γ the narrower the peak
- Assume $\omega_0 \approx \omega$, then the equation can be simplified
  - The max power can be determined to be $\dfrac{F_0^2}{2m\gamma}$

Example: RLC Circuit

- $\dfrac{\mathrm{d}^2 q}{\mathrm{d}t^2} + \dfrac{R}{L}\dfrac{\mathrm{d}q}{\mathrm{d}t} + \dfrac{1}{LC}q = \dfrac{\epsilon_0}{L}\cos(\omega t)$
- The solution gives an amplitude similar to that of the mass spring system

Transient Response

- Eventually the frequency of the driven oscillator matches the frequency of the driver
- The system has inertia, so initially the system is inclined to oscillate at its natural frequency
- In the initial period we have a sum of two oscillations, the driven and natural
- For damped oscillators the frequency ω_0 oscillations will dissipate at a rate depending on γ
  - This is called the *transient response*