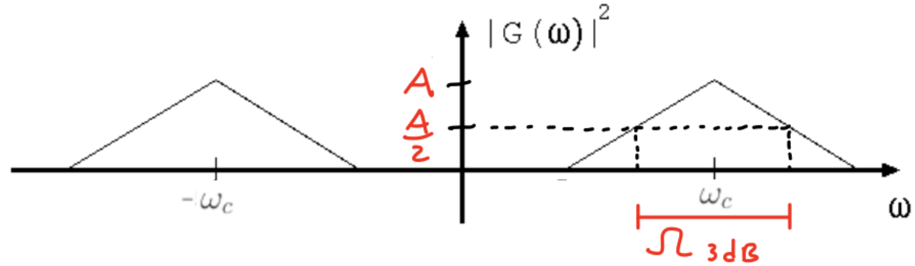
Lecture 34, Monday, March 28, 2022

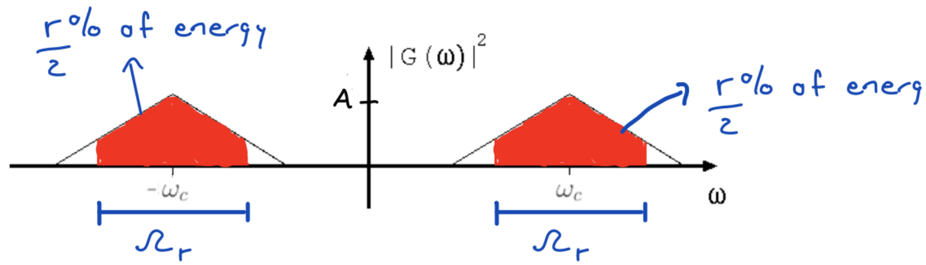
- Energy bandwidth
  - Bandpass signals
    - Assume the energy spectrum, $|F(\omega)|^2$, is symmetric around a center frequency ω_c
    - 3dB bandwidth (Ω_{3dB}):
      - First find smallest $\hat{\omega} > 0$ such that

$$\frac{|F(\omega_c + \hat{\omega})|^2}{|F(\omega_c)|^2} = \frac{1}{2}$$



      - Then $\Omega_{3dB} = 2\hat{\omega}$
    - r% bandwidth (Ω_r):
      - First find smallest $\hat{\omega}$ such that

$$\frac{1}{2\pi}\int_{\omega_c-\hat{\omega}}^{\omega_c+\hat{\omega}} |F(\omega)|^2 d\omega = \frac{r}{100}\frac{W}{2}$$



      - Then $\Omega_r = 2\hat{\omega}$

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- LTI system response with Fourier transform:

$$f(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F(\omega)e^{j\omega t}d\omega \;\longrightarrow \boxed{\text{LTI}} \longrightarrow y(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} H(\omega)F(\omega)e^{j\omega t}d\omega$$

$$F(\omega) \;\longrightarrow \boxed{\text{LTI}} \longrightarrow Y(\omega) = H(\omega)F(\omega)$$

$F(\omega)$ acts like the phasor representation of $f(t)$ at frequency ω

- Can now obtain transient response, not just steady state response, but just from input, not from initial state