$$G(s) = \frac{V_L(s)}{V_s(s)} = \frac{Z_C}{Z_R + Z_L + Z_C} = \frac{1/Cs}{R + Ls + 1/Cs}$$

$$= \frac{1}{LCs^2 + RCs + 1} = \frac{1/LC}{s^2 + \frac{R}{L}s + 1/LC}$$

$$\omega_n^2 = \frac{1}{LC} \rightarrow \omega_n = \frac{1}{\sqrt{LC}} \text{ rad/sec} \rightarrow f_n = \frac{1}{2\pi\sqrt{LC}} \text{ Hz}$$

$$2\xi\omega_n = \frac{R}{L} \rightarrow \xi = \frac{R}{2L\omega_n} = \frac{R}{2L\left(\frac{1}{\sqrt{LC}}\right)} = \frac{1}{2} R \sqrt{\frac{C}{L}}$$

* Transient Analysis $(t = 0^+)$

example: $v_s(t) = V u(t)$

$$V_s(s) = \frac{V}{s}$$

$$V_c(s) = G(s) \cdot V_s(s) \rightarrow v_c(t) = \mathcal{L}^{-1}\{V_c(s)\}$$