

Electronic oscillator circuit

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Solution: a. The equation of motion of the damped and forced spring mass system is,

$$ma + bv + kx = F_0 \cos \omega t .$$

The solutions are,

$$\begin{aligned} \tan \delta &= \frac{\sin \delta}{\cos \delta} = \frac{\operatorname{Im} e^{i\delta}}{\operatorname{Re} e^{i\delta}} = \frac{R\omega}{L(\omega_0^2 - \omega^2)} \\ A &= |Ae^{-i\delta}| = \left| \frac{U_0\omega}{L(\omega_0^2 - \omega^2) + i\omega R} \right| = \frac{U_0\omega}{\sqrt{L^2(\omega_0^2 - \omega^2)^2 + R^2\omega^2}} . \end{aligned}$$

b. The natural frequency is,

$$\omega_0 = \frac{1}{\sqrt{LC}} .$$

c. Quality factor can be increased by decreasing strength R ,

$$Q = \frac{1}{R} \sqrt{\frac{L}{C}} .$$