

1. Suppose you have a mass-spring harmonic oscillator where $m = 2$, $c = 4$, and $k = 10$. However, an outside force is acting on the system via the function $F(t) = t^2 + 2e^{-t}$. Determine the particular solution satisfying $x(0) = 2$ and $x'(0) = -2$.

2. Consider an RLC circuit with $R = 30$ ohms Ω , $L = 10$ henry (H), and $C = 0.02$ farad (F). At time $t = 0$, when both $I(0)$ and $Q(0)$ are zero, the switch in the circuit is closed and an alternating current given by $E(t) = 50 \sin(2t)$ is allowed into the circuit. Find the current in the circuit and the time lag of the steady periodic current behind the voltage.

3. Given the differential equation $\frac{d^2y}{dt^2} + 11y = 2 \cos(3t)$, determine the general solution, the frequency of the beats, and the frequency of rapid oscillations.