Let us consider the RLC circuit below with a switch open at t=0.

(a). Derive the characteristic equation of the circuit in terms of a complex number s.

KCL in terms of $2t\theta\lor +70$ is

$$1 \frac{di}{dt} + \frac{1}{2t \cdot 10^2} \int ic \leq \int t+\int (30+50) i = 0 \text{ or } \frac{di^2}{dt^2} + 100 \frac{di}{dt} + 2500 i = 0$$

$$\Rightarrow s^2 + 100s + 2500 = 0 \text{ or } (s+50)^2 = 0$$

Answer $s^2 + 100s + 2500 = 0$ ($s = 50, \omega_0 = 50$)

(b). Is this circuit over-damped, critically damped or under-damped?

Answer critically damped

Justification $\lambda = \omega_0 = 50$ (hint: consider $\alpha, \omega_0$)

(c). Find the value of $\frac{di(t+\theta)}{dt}$.

Just before the switch is opened, in DC steady state, the capacitor is open-circuited ($C \frac{dv}{dt} = 0$ no current through it). Thus $v_t = \sqrt{30} = 50 \frac{30}{30+50} = 30V$ Also $i(0^-) = 0 = i(0^+)$

$a(t+\theta) = a$, \quad $1 \frac{di}{dt} = -v_c$, $v_c = -30 \quad i(0) = 0$ \boxed{\frac{di(t)}{dt} = -30}$