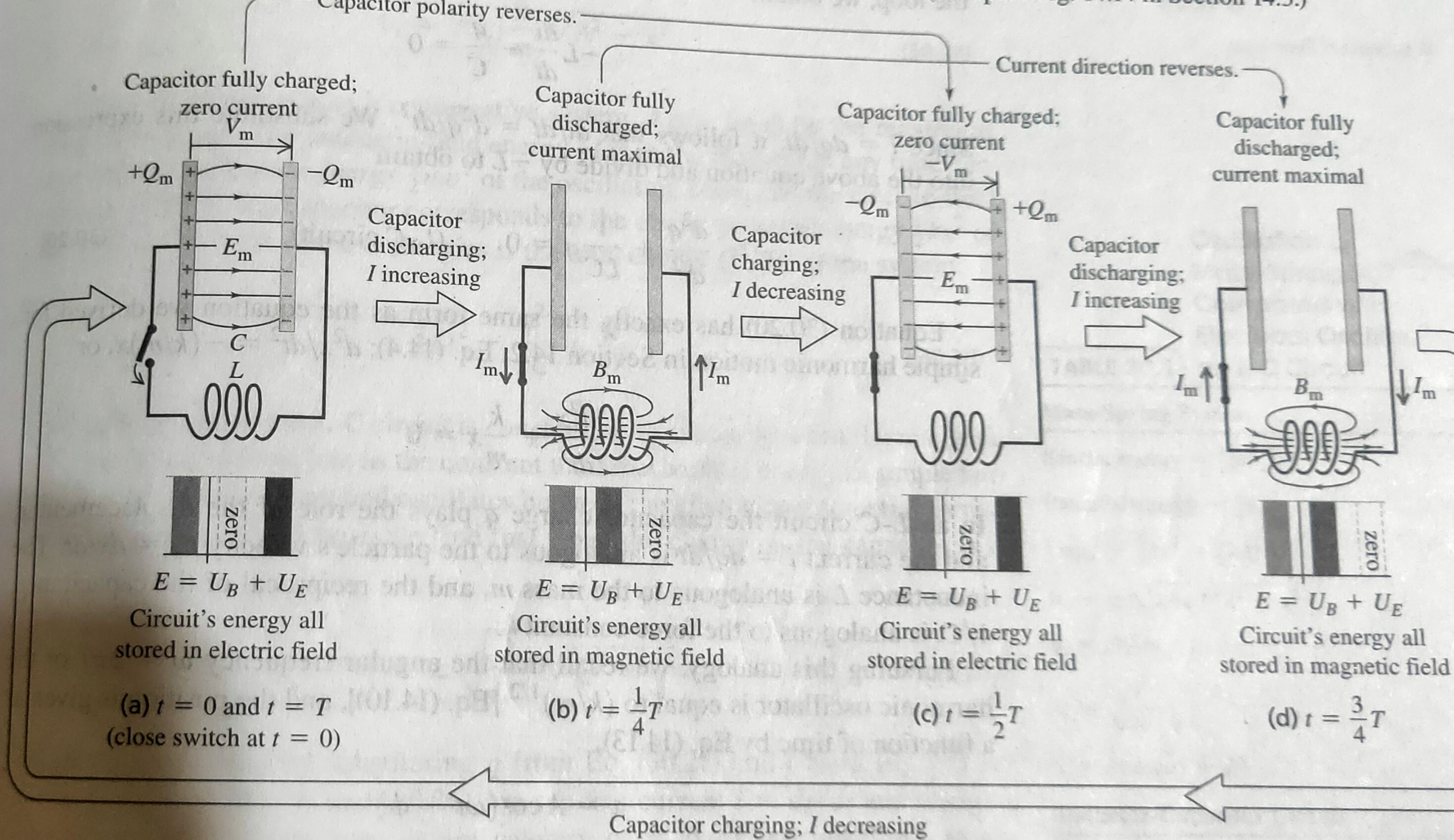
# The L-C Circuit

The L-C Circuit :- A circuit containing an inductor and a capacitor shows an entirely new mode of behavior characterized by oscillating current and charge. In the L-C circuit in fig (1)(a) we charge the capacitor to a potential difference $V_m$ and initial charge $Q_m = CV_m$ on its left hand plate and then close the switch.

Then the capacitor begins to discharge through the inductor. Because of the induced emf in the inductor, the current cannot change instantaneously. It starts at zero and eventually builds up to a maximum value $I_m$. During this build the capacitor is discharging. At each instant the capacitor potential equals the induced emf, so as the capacitor discharges, the rate of change of current decreases. when the capacitor discharges, the rate of change of current decreases. when the capacitor potential equals the induced emf, so as the capacitor discharges, the rate of change of current decreases. when the capacitor potential becomes zero, the induced emf is also zero, and the current has leveled off at its maximum value $I_m$. as shown in fig (1)(b) fig ① In an oscillating L-C circuit, the charge on the capacitor & current through the inductor both vary sinusoidally with time. Energ is transferred b/n magnetic energy in inductor ($U_B$) & Electrical energy in the capacitor ($U_E$). As in simple harmonic motion, the total energy E remains constant.


Capacitor polarity reverses.
Current direction reverses.
Capacitor fully charged; zero current
$V_m$
$+Q_m$
$-Q_m$
$E_m$
$C$
$L$
Capacitor discharging; I increasing
Capacitor fully discharged; current maximal
$I_m$
$B_m$
$I_m$
Capacitor charging; I decreasing
Capacitor fully charged; zero current
$-V_m$
$-Q_m$
$+Q_m$
$E_m$
Capacitor discharging; I increasing
Capacitor fully discharged; current maximal
$I_m$
$B_m$
$I_m$
zero
zero
zero
zero
$E = U_B + U_E$
Circuit's energy all stored in electric field
(a) $t = 0$ and $t = T$ (close switch at $t = 0$)
$E = U_B + U_E$
Circuit's energy all stored in magnetic field
(b) $t = \frac{1}{4}T$
$E = U_B + U_E$
Circuit's energy all stored in electric field
(c) $t = \frac{1}{2}T$
$E = U_B + U_E$
Circuit's energy all stored in magnetic field
(d) $t = \frac{3}{4}T$
Capacitor charging; I decreasing

The capacitor has completely discharged. The potential difference between its terminals (and those of the inductor) has decreased to zero, and current has reached its maximum value $I_m$.

During the discharge of the capacitor the increasing current in the inductor has establised a magnetic fied in the space around it ~~and~~ the energy that ~~has~~ was initially stored in the capacitor's electric field is now stored in the inductor's magnetic field.

Although the capacitor is completely discharge in fig (1)(b) the current persists and the capacitor begins to charge with polarity opposite to that in the initial state. As the current decreases, the magnetic field also decreases, ~~induct~~ inducing an emf in the inductor in the same direction as the current. Eventually, the current and the magnetic field reach zero, and capacitor has been charged in the sense opposite to its initial polarity like fig (1)(c) with potential difference $-V_m$ and charge $-Q_m$ on its left hand plate.

The process now repeats in reverse direction. a little later, the capacitor has again discharged & there is a current in the inductor in the opposite direction fig ① ⓓ. still later the capacitor charge returns to its original value like fig ① ⓐ. and the whole process repeats.

If there are no energy losses, the charges on the capacitor continue to oscillate back & forth indefinitely. This process is called an electrical oscillation.

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