Basrah University
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Electric Circuits Analysis

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Chapter Two
Part 3

Transient Circuits

- ***General Second-Order Circuits***

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Transient Circuits

2.12 General Second-Order Circuits

Now that we have mastered series and parallel RLC circuits, we are prepared to apply the ideas to any second-order circuit having one or more independent sources with constant values. Although the series and parallel RLC circuits are the second-order circuits of greatest interest, other second-order circuits are also useful. Given a second-order circuit, we determine its step response $x(t)$ (which may be voltage or current) by taking the following four steps :-

1- We first determine the initial conditions $x(0)$ and $\frac{dx(0)}{dt}$ and the final value (steady state value.

2- We turn off the independent sources and find the form of the transient response $x_t(t)$ by applying KCL and KVL. Once a second-order differential equation is obtained, we determine its characteristic roots. Depending on whether the response is overdamped, critically damped, or underdamped, we obtain $x_t(t)$ with two unknown constants as we did in the previous sections.

3- The total response is now found as the sum of the transient response and steady-state response.

$$x(t) = x_t(t) + x_{ss}(t) \qquad \ldots(2.69)$$

4- We finally determine the constants associated with the transient response by imposing the initial conditions $x(0)$ and $\frac{dx(0)}{dt}$determined in step 1.

Example 2.16:- Find the complete response $v(t)$ & $i(t)$ in circuit in the Fig. 2.39.

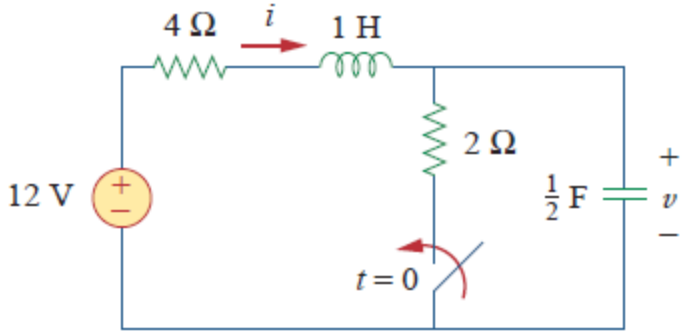

Fig 2.39 For Example 2.16

Example 2.17:- Find $v_0(t)$ for $t > 0$ in circuit in the Fig. 2.40.

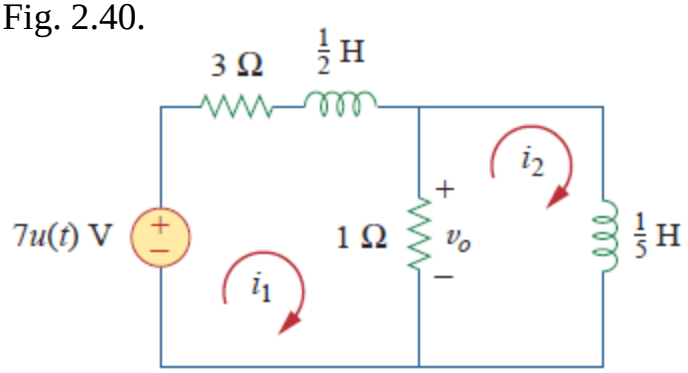

Fig 2.40 For Example 2.17