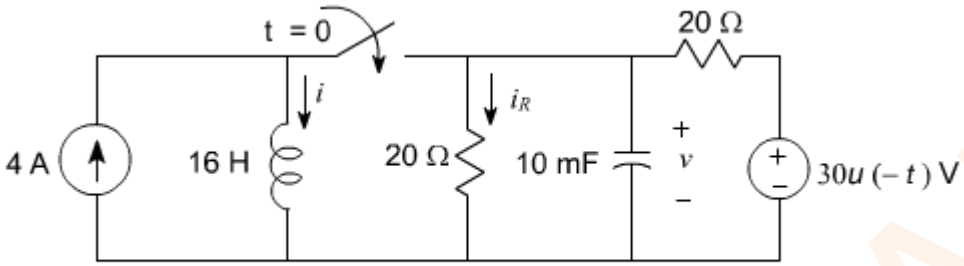
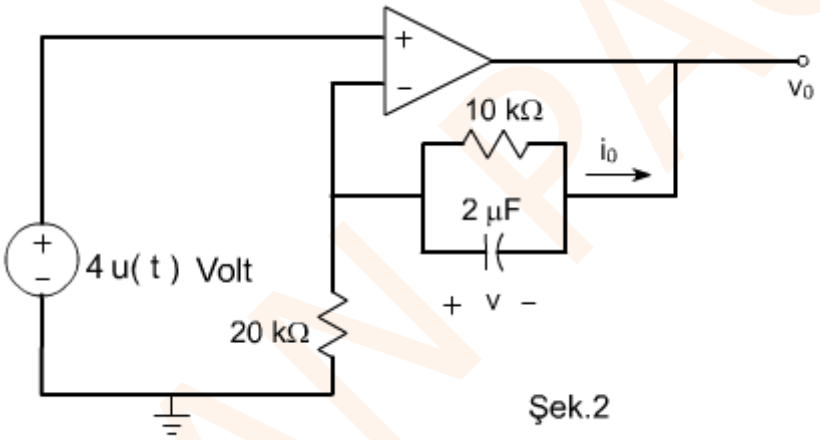
ELEKTRİK DEVRELERİ I FİNAL 2008 - 2009

SORU 1 -) ***Şekildeki devrede*** $t > 0$ ***için*** i ***ve*** i_R ***akımını bulunuz.***



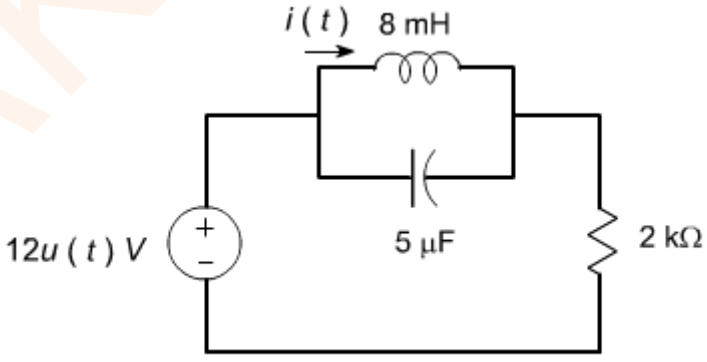
Şekil 1

SORU 2 -) ***Şekildeki devrede*** $v(0) = 1V$ ***tur.*** v_0 ***ve*** i_0 ***değerlerini hesaplayınız.***



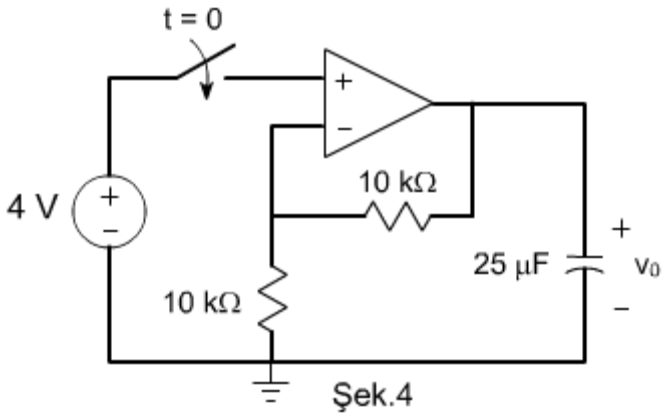
Şek.2

SORU 3 -) ***Şekildeki devrede*** $t > 0$ ***için*** $i(t)$ ***akımını bulunuz.***



Şek.3

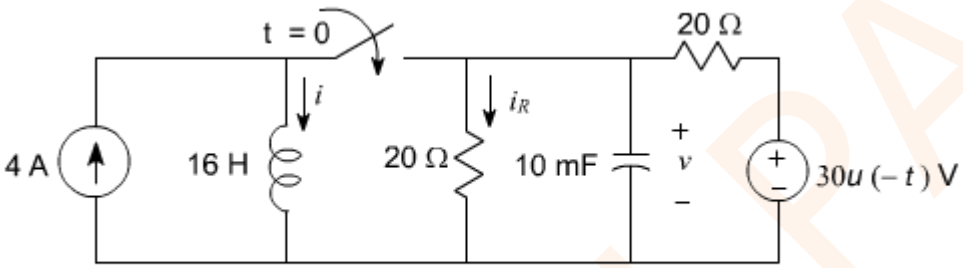
SORU 4 -) ***Şekildeki devrede*** $t > 0$ ***için*** v_0 ***gerilimini bulunuz. Kondansatör başlangıçta şarjsızdır.***



Şek.4

ÇÖZÜMLER

ÇÖZÜM 1 -)



Şekil 1

Başlangıç şartları

$i(0^-) = 4$

$v(0^-) = \frac{30}{20+20} \times 20 = 15$

$v = 16\frac{di}{dt}$

$$\frac{di(0)}{dt} = \frac{v(0)}{16} = \frac{15}{16} = 0.9375$$

$$\frac{v}{20} + \frac{v}{20} + 10\times10^{-3}\frac{dv}{dt} + i - 4 = 0, \qquad \frac{v}{10} + 10\times10^{-3}\frac{dv}{dt} + i = 4$$

$$v = 16\frac{di}{dt}$$

$$\frac{1}{10}\times16\frac{di}{dt} + 10\times10^{-3}\times16\frac{d^2i}{dt^2} + i = 4, \qquad \frac{d^2i}{dt^2} + 10\frac{di}{dt} + 6.25i = 25$$

$$\frac{d^2i}{dt^2} + 10\frac{di}{dt} + 6.25i = 25$$

Doğal çözüm:

$$\frac{d^2i}{dt^2} + 10\frac{di}{dt} + 6.25i = 0,\ s^2 + 10s + 6.25 = 0, \qquad s_{1,2} = \frac{-10 \pm \sqrt{10^2 - 4\times6.25}}{2}$$

$s_1 = -0.67$ $\qquad$ $s_2 = -9.33$

$$i_n = Ae^{-0.67t} + Be^{-9.33t}$$

Zorlanmış çözüm:

$$i_f = K,\ \frac{d}{dt^2}K + 10\frac{d}{dt}K + 6.25K = 25, \qquad i_f = K = 4$$

Tam çözüm:

$$i = i_n + i_f = Ae^{-0.67t} + Be^{-9.33t} + 4$$

$$i(0) = 4 = Ae^{-0.67\times 0} + Be^{-9.33\times 0} + 4, \qquad A + B = 0, \qquad A = -B$$

$$\frac{di}{dt} = -6.7Ae^{-0.67t} - 9.33Be^{-9.33t},$$

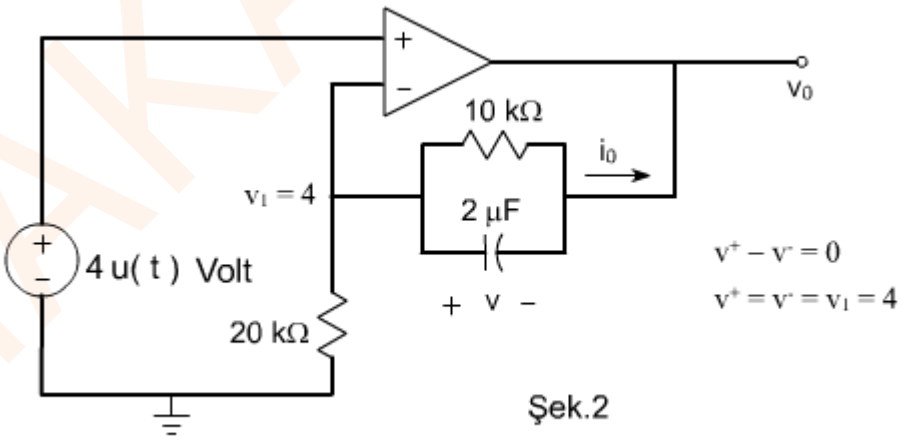
$$\frac{di(0)}{dt} = -0.67Ae^{-0.67\times 0} - 9.33Be^{-9.33\times 0} = 0.9375 = -0.67A - 9.33B = -0.67A + 9.33A = 8.66A$$

$$A = \frac{0.9375}{8.66} = 0.10825635\ 1, \qquad \mathrm{B} = -0.10825635\ 1$$

$$i = i_n + i_f = 0.108e^{-0.67t} - 0.108e^{-9.33t} + 4, \quad v = 16\frac{di}{dt} = -1.158e^{-0.67t} + 16.12e^{-9.33t}$$

$$i_R = \frac{v}{20} = -0.0575e^{-0.67t} + 0.806e^{-9.33t}$$

ÇÖZÜM 2 -)



Şek.2

$$\frac{v_1}{20\times 10^3} + \frac{v_1 - v_0}{10\times 10^3} + 2\times 10^{-6}\frac{d}{dt}(v_1 - v_0) = 0$$

$$25v + 50(v_1 - v_0) + \frac{d}{dt}(v_1 - v_0) = 0, \qquad 25\times 4 + 50(4 - v_0) + \frac{d}{dt}(4 - v_0) = 0$$

$$25\times 4 + 50(4 - v_0) + \frac{d}{dt}(4 - v_0) = 0$$

$$\frac{dv_0}{dt} + 50v_0 = 300$$

Doğal çözüm:

$$\frac{dv_0}{dt} + 50v_0 = 0,\ s + 50 = 0, \qquad s = -50$$

$$v_{0n} = Ae^{-50t}$$

Zorlanmış çözüm:

$$v_{0f} = K,\ \frac{d}{dt}K + 50K = 300, \qquad v_{0f} = K = 6$$

Tam çözüm

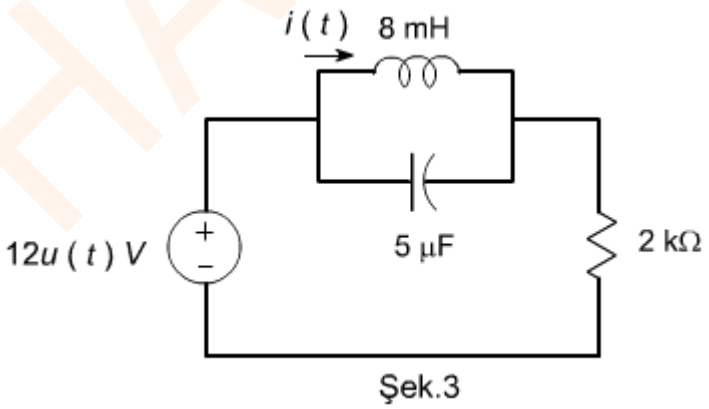
$$v_0 = v_{0n} + v_{0f} = Ae^{-50t} + 6$$

$$v(0) = 4 - v_0(0) = 1, \qquad v_0(0) = 3 = Ae^{-50\times 0} + 6, \qquad A = -3$$

$$v_0 = -3e^{-50t} + 6$$

$$i_0 = \frac{4 - v_0}{10k} = \frac{3e^{-50t} - 2}{10k} = (-0.3e^{-50t} - 0.2)\ mA$$

ÇÖZÜM 3 -)



Şek.3

$$v_L = L\frac{di}{dt}$$

$v_L = v_C$ paralel

$$i_c = C\frac{dv_C}{dt}$$

$$i_c = C\frac{d}{dt}\left(L\frac{di}{dt}\right) = CL\frac{d^2i}{dt^2}$$

$t < 0$ iken

$$i(0^-) = 0,\ v_C(0) = 0,\ v_L = L\frac{di}{dt}, \qquad \frac{di}{dt} = \frac{v_L(0^-)}{L} = \frac{v_C(0^-)}{L} = 0$$

Çevre $-12 + v_L + R(i + i_C) = 0,\ v_L + Ri + Ri_C = 12$

$$L\frac{di}{dt} + Ri + RCL\frac{d^2i}{dt^2} = 12$$

$$\frac{d^2i}{dt^2} + \frac{1}{RC}\frac{di}{dt} + \frac{1}{CL}i = \frac{1}{RCL}12$$

$$\frac{1}{RC} = \frac{1}{2\times10^3 \times 5\times10^{-6}} = 100$$

$$\frac{1}{CL} = \frac{1}{5\times10^{-6}\times8\times10^{-3}} = 25\times10^6, \quad \frac{1}{RCL} = \frac{1}{2\times10^3\times5\times10^{-6}\times8\times10^{-3}} = 12500$$

$$\frac{d^2i}{dt^2} + 100\frac{di}{dt} + 25\times10^6 i = 12500\times12 = 150\ 000$$

$$\frac{d^2i}{dt^2} + 100\frac{di}{dt} + 25\times10^6 i = 150\times10^3$$

Doğal çözüm

$$s^2 + 100s + 25\times10^6 = 0$$

$$s_{1,2} = \frac{-100 \pm \sqrt{(100)^2 - 4\times25\times10^6}}{2} = -50 \pm j4999.75 \cong -50 \pm j5000$$

$$i_n = e^{-50t}(A\cos5000t + B\sin5000t)$$

Zorlanmış çözüm:

$$i_f = K, \quad \frac{d^2i}{dt^2} + 100\frac{di}{dt} + 25\times10^6 i = 150\times10^3, \quad \frac{d^2}{dt^2}K + 100\frac{d}{dt}K + 25\times10^6 K = 150\times10^3$$

$$i_f = K = 6\times10^{-3}$$

$$i = i_n + i_f = e^{-50t}(A\cos5000t + B\sin5000t) + 6\times10^{-3}$$

$$i(0) = e^{-50\times 0}(A\cos 5000\times 0 + B\sin 5000\times 0) + 6\times 10^{-3} = 0, \qquad A + 6\times 10^{-3} = 0$$

$$A = -6\times 10^{-3}$$

$$\frac{di}{dt} = -50e^{-50t}(A\cos 5000t + B\sin 5000t) + e^{-50t}(-5000\,A\sin 5000t + 5000\,B\cos 5000t)$$

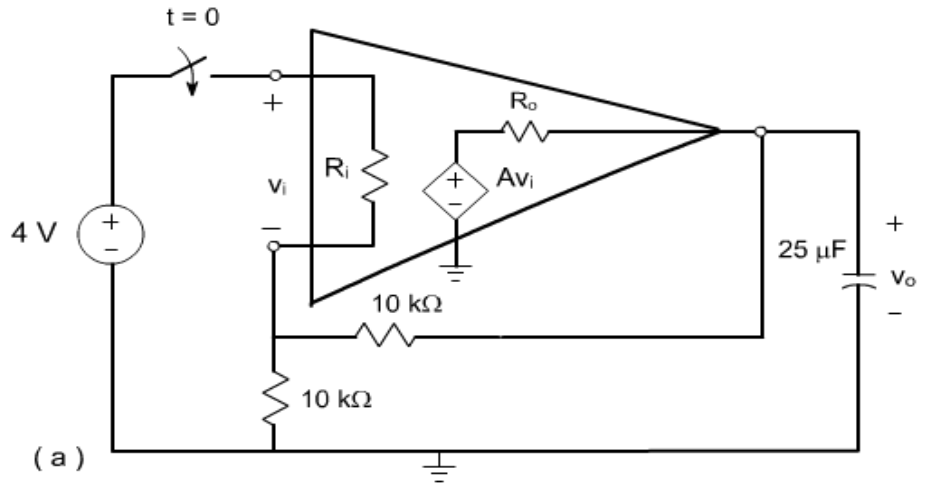
$$\frac{di(0)}{dt} = -50e^{-50\times 0}(A\cos 5000\times 0 + B\sin 5000\times 0)$$
$$+ e^{-50\times 0}(-5000\,A\sin 5000\times 0 + 5000\,B\cos 5000\times 0) = 0$$

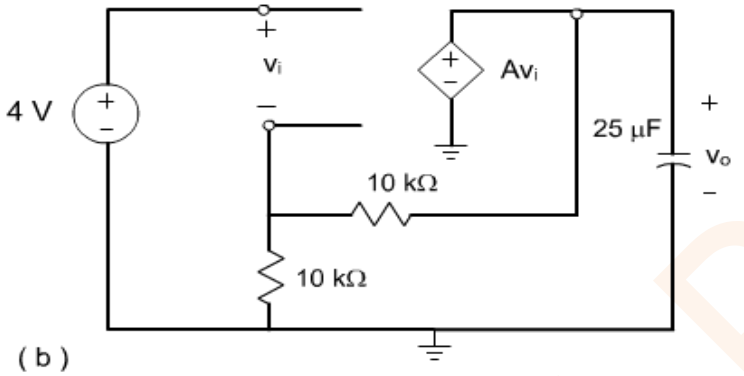
$$\frac{di(0)}{dt} = -50A + 5000B = 0, \qquad A = 100B, \qquad B = 0.01A = -0.01\times 6\times 10^{-3}$$

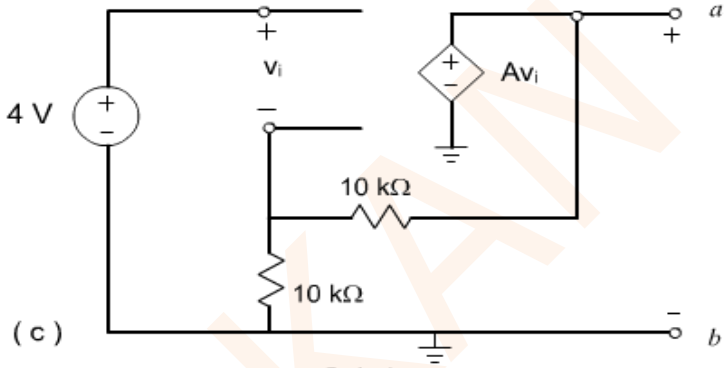
$$i = 6\times 10^{-3} + e^{-50t}(-6\times 10^{-3}\cos 5000t - 0.01\times 6\times 10^{-3}\sin 5000t)\ A$$

$$i = 6 - 6e^{-50t}(\cos 5000t + 0.01\sin 5000t)\ mA$$

ÇÖZÜM 4 -)

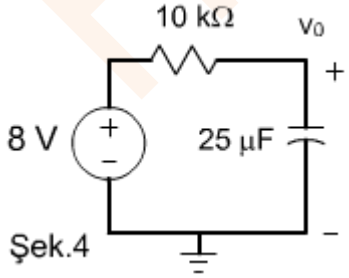






Şek.4

$$\frac{v_0-8}{10k}+25\times10^{-6}\frac{dv_0}{dt}=0$$



Şek.4

$$\frac{10^6}{25}\frac{v_0-8}{10\times10^3}+\frac{dv_0}{dt}=0$$

$$\frac{dv_0}{dt}+4v_0=32$$

Doğal çözüm:

$$\frac{dv_0}{dt}+4v_0=0$$

$$s+4=0$$

Kondansatörü çıkartıp,

a ***ile*** b ***noktaları arasındaki devrenin Thevenin eşdeğeri bularak*** v_0 ***gerilimini bulacağız.***

Açık devre gerilimi

$v_{ab}=v_{Th}$ ***bulalım.***

$$v_n=v_p=4$$

$$\frac{v_n}{10k}+\frac{v_n-v_{ab}}{10k}=0$$

$$v_{ab}=4+4=8$$

Kısa devre akımı

$$i_{sc}=4/(10k//10k)$$

$$i_{sc}=0.8\,mA$$

$$R_{Th}=\frac{v_{oc}}{i_{sc}}$$

$$R_{Th}=\frac{8}{0.8\times10^{-3}}$$

$$R_{Th}=10\ k\Omega$$

$$\frac{v_0-8}{10k}+25\times10^{-6}\frac{dv_0}{dt}=0$$

$v_{0n} = Ae^{-4t}$

Zorlanmış çözüm:

$$\frac{d}{dt}K + 4K = 32, \qquad v_{0f} = K = 8$$

Tam çözüm :

$$v_0 = v_{0n} + v_{0f} = Ae^{-4t} + 8$$

$$v_0 = v_{0n} + v_{0f} = Ae^{-4t} + 8, \qquad v_0(0) = 0 = Ae^{-4\times 0} + 8, \qquad A = -8$$

$$v_0 = 8 - 8e^{-4t}$$