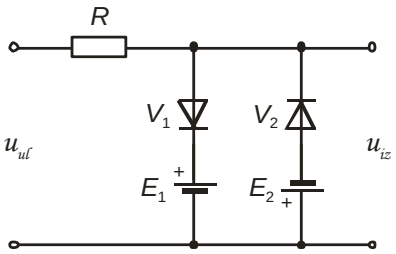
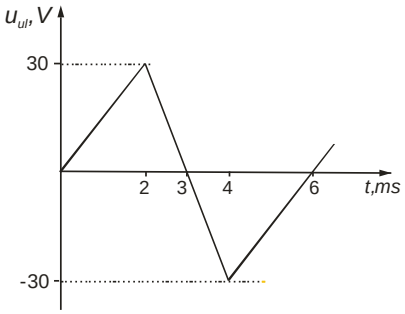
11.04.2006., Zagreb

6. domaća zadaća iz Elektroničkih komponenata

1. Nacrtajte izlazni napon u_{iz} te izračunajte njegovu srednju vrijednost U_{sr} ako je na ulaz sklopa spojen periodički napon maksimalne vrijednosti U_m = 30 V prema slici. Poznato je: E_1 = 15 V, E_2 = 20 V, a diode su idealne.

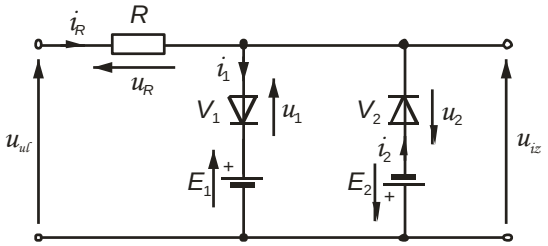




Rješenje

1. Kirchhoffovi zakoni za krug:

$$u_{iz} = u_{ul} - u_R$$
$$u_{iz} = E_1 + u_1$$
$$u_{iz} = -E_2 - u_2$$
$$i_R = i_1 - i_2$$



Sklop ima tri režima rada u kojima vodi ili prva dioda ili druga dioda ili ne vodi nijedna dioda.

$u_{ul} > E_1$

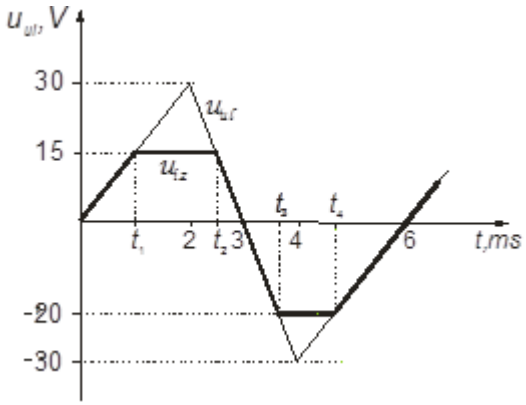
Vodi dioda V_1 ... $u_1 = 0$, $u_{iz} = E_1$

$u_{ul} < -E_2$

Vodi dioda V_2 ... $u_2 = 0$, $u_{iz} = -E_2$

$-E_2 \le u_{ul} \le E_1$

Ne vodi nijedna dioda ... $i_1, i_2 = 0$, $i_R = 0$, $u_R = R \cdot i_R = 0$, $u_{iz} = u_{ul}$



Trenutci uklapanja i isklapanja dioda:

- iz sličnosti trokuta

$$\frac{t_1}{u_{ul}(t_1)} = \frac{2}{U_m}, \qquad T = 6\ ms \qquad \frac{t_3 - \frac{T}{2}}{u_{ul}(t_3)} = \frac{4 - \frac{T}{2}}{-U_m}$$

$$t_1 = 1ms \qquad t_3 = 3{,}\dot{6}\,ms$$

$$\frac{\frac{T}{2} - t_2}{u_{ul}(t_2)} = \frac{\frac{T}{2} - 2}{U_m} \qquad \frac{T - t_4}{u_{ul}(t_4)} = \frac{T - 4}{-U_m}$$

$$t_2 = 2{,}5ms \qquad t_4 = 4{,}\dot{6}\,ms$$

$$U_{sr} = \frac{ukupna\ površina\ ispod\ \ krivulje\ napona\ na\ \ jednoj\ \ periodi}{trajanje\ periode}$$

$$U_{sr} = -\frac{\frac{(U_m - E_1)\cdot(t_2 - t_1)}{2} - \frac{(U_m - E_2)\cdot(t_4 - t_3)}{2}}{T}$$

$$\boxed{U_{sr} = -1{,}042\ V}.$$