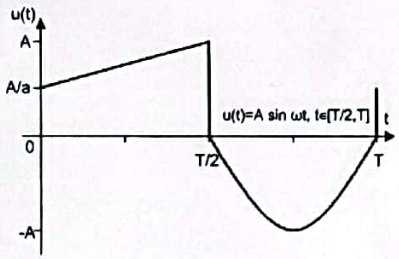
Broj indeksa: | Ime i prezime: Marina | Kombinacija broj: 1

1. ZADATAK IZ ZBIRKE

Napon talasnog oblika kao na slici, dovodi se na voltmetar sa kretnim kalemom i jednostranim ispravljačem, podešen da pokazuje efektivnu vrednost sinusnog napona. Odrediti apsolutnu vrednost relativne greške merenja efektivne vrednosti datog napona ovim voltmetrom. $A = 4.5$ V, $a = 1.5, f = 52$ Hz.



	a	b	c	d	e	
Odgovori:	19.31 %	5.70 %	8.87 %	13.19 %	3.31 %	*(16 bodova)*

2. Otpornik nepoznate otpornosti R_x se meri U/I metodom, naponskim spojem. Kada se za merenje napona u ovoj metodi koristi voltmetar sa mekim gvožđem, klase tačnosti 1.0 i unutrašnje otpornosti 2500 Ω, ampermetar sa kretnim kalemom, opsega 1.2 mA, pokazuje 0.5 mA. Kada se umesto prvog, veže drugi voltmetar, klase tačnosti 0.5 i unutrašnje otpornosti 1000 Ω, ampermetar pokazuje 0.6 mA. Za ampermetar, unutrašnje otpornosti 120 Ω, smatramo da meri sa zanemarivom greškom. Kolo se napaja iz idealnog izvora jednosmernog napona. Odrediti vrednost R_x.

	a	b	c	d	e	
Odgovori:	7786 Ω	2214 Ω	544 Ω	3968 Ω	1205 Ω	*(16 bodova)*

3. Kolika je kombinovana merna nesigurnost paralelne veze dva otpornika čiji je odnos otpornosti 4, a standardne merne nesigurnosti otpornika su jednake i iznose 1 %?

	a	b	c	d	e	
Odgovori:	0.71 %	0.82 %	0.85 %	0.75 %	0.79 %	*(16 bodova)*

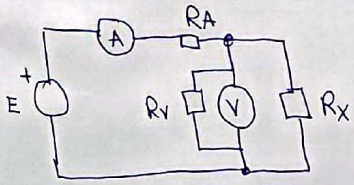
4. ZADATAK IZ ZBIRKE

Za koliko se promeni struja mikroampermetra u naizmeničnom mostu u okolini ravnotežnog stanja, kada dođe do promene vrednosti induktivnosti L za 1.0 %?

$R_1 = 0.5$ kΩ, $R_2 = R_3 = 1$ kΩ, $R_4 = 2$ kΩ, $L = 100$ mH, $C = 100$ nF, $U = 3$ V, $f = 50$ Hz.

	a	b	c	d	e	
Odgovori:	40 nA	4 nA	200 nA	20 nA	400 nA	*(16 bodova)*

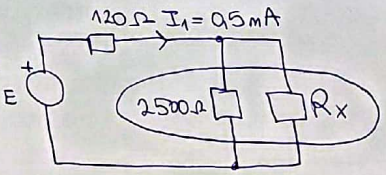
2. $R_x = ?$ **UI metoda naponski spoj** →



A kk: $I_{max} = 1{,}2\ mA$, $R_A = 120\ \Omega$, $I_1 = 0{,}5\ mA$

V1 MG: $kl_{V_1} = 1\%$, $R_{V_1} = 2500\ \Omega$

I merenje →



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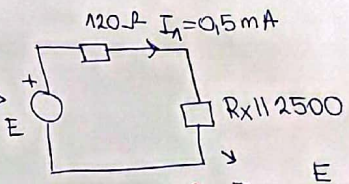
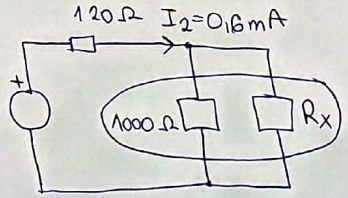


(1) $I_1 = \dfrac{E}{120 + Rx \parallel 2500}$

V2: $kl_{V_2} = 0{,}5\%$, $R_{V_2} = 1000\ \Omega$

A kk: $I_{max} = 1{,}2\ mA$, $I_2 = 0{,}6\ mA$

II merenje →



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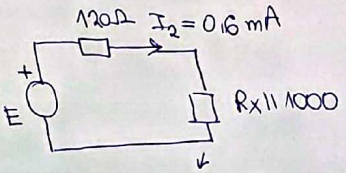


(2) $I_2 = \dfrac{E}{120 + Rx \parallel 1000}$

(1) (2) $\dfrac{I_1}{I_2} = \dfrac{\frac{E}{120 + Rx \parallel 2500}}{\frac{E}{120 + Rx \parallel 1000}}$

$\frac{10}{10} \cdot \frac{0{,}5\ \cancel{mA}}{0{,}6\ \cancel{mA}} = \dfrac{120 + Rx \parallel 1000}{120 + Rx \parallel 2500}$

$\dfrac{5}{6} = \dfrac{120 + Rx \parallel 1000}{120 + Rx \parallel 2500}$

$5 \cdot (120 + 2500 \parallel Rx) = 6 \cdot (120 + 1000 \parallel Rx)$

$600 + 5(2500 \parallel Rx) = 720 + 6(1000 \parallel Rx)$

$600 + 5\dfrac{12500 \cdot Rx}{2500 + Rx} = 720 + 6 \cdot \dfrac{1000 \cdot Rx}{1000 + Rx}$

$\dfrac{12500 Rx}{2500 + Rx} = 120 + \dfrac{6000 Rx}{1000 + Rx} \quad / : 10$

$\dfrac{1250 Rx}{2500 + Rx} = 12 + \dfrac{600 Rx}{1000 + Rx}$

$\dfrac{1250 Rx}{2500 + Rx} = \dfrac{12(1000 + Rx) + 600 Rx}{1000 + Rx}$

$\dfrac{1250 Rx}{2500 + Rx} = \dfrac{612 Rx + 12000}{1000 + Rx}$

$1250 Rx \cdot (1000 + Rx) = (2500 + Rx)(612 Rx + 12000)$

$1250000 Rx + 1250 Rx^2 = 1530000 Rx + 30000000 + 612 Rx^2 + 12000 Rx$

$638 Rx^2 - 292000 Rx - 30000000 = 0$

$Rx_{1/2} = \dfrac{292000 \pm \sqrt{8{,}5264 \cdot 10^{10} + 7{,}656 \cdot 10^{10}}}{1276}$

$Rx_{1/2} = \dfrac{292000 \pm 4{,}022\,73538 \cdot 10^{5}}{1276}$

$Rx_{1/2} = \dfrac{292000 \pm 402273{,}538}{1276}$

⇒ $Rx_1 = 544{,}1015\ \Omega$

$Rx_2 = -86{,}4212\ \Omega$ ↯

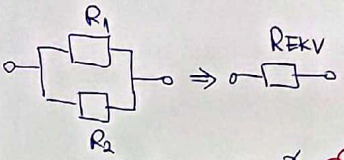
⇒ $Rx_1 = 544\ \Omega$

3. $\frac{u(R_{EKV})}{R_{EKV}} = ?$

$\frac{u(R_1)}{R_1} = 1\% \Rightarrow \frac{u(R_1)}{R_1} = 0{,}01 \Rightarrow u(R_1) = 0{,}01 \cdot R_1 \overset{*}{=} 0{,}01 \cdot 4R_2 = 0{,}04R_2$

$\frac{u(R_2)}{R_2} = 1\% \Rightarrow \frac{u(R_2)}{R_2} = 0{,}01 \Rightarrow u(R_2) = 0{,}01 \cdot R_2$

$\frac{R_1}{R_2} = 4 \Rightarrow \boxed{R_1 = 4R_2}$ *



$R_{EKV} = \frac{R_1 \cdot R_2}{R_1 + R_2} \overset{*}{=} \frac{4R_2^2}{5R_2} = \frac{4}{5}R_2$

$\frac{\partial R_{EKV}}{\partial R_1} = \frac{R_2(R_1+R_2) - R_1R_2}{(R_1+R_2)^2} = \frac{R_2^2}{(R_1+R_2)^2} =$

$= \left(\frac{R_2}{R_1+R_2}\right)^2 \overset{*}{=} \left(\frac{R_2}{5R_2}\right)^2 = \frac{1}{25}$

$\frac{\partial R_{EKV}}{\partial R_2} = \frac{R_1(R_1+R_2) - R_1R_2}{(R_1+R_2)^2} = \frac{R_1^2}{(R_1+R_2)^2} =$

$= \left(\frac{R_1}{R_1+R_2}\right)^2 \overset{*}{=} \left(\frac{4R_2}{5R_2}\right)^2 = \frac{16}{25}$

$u(R_{EKV}) = \sqrt{\left(\frac{\partial R_{EKV}}{\partial R_1}\right)^2 \cdot u^2(R_1) + \left(\frac{\partial R_{EKV}}{\partial R_2}\right)^2 \cdot u^2(R_2)}$

$u(R_{EKV}) = \sqrt{\left(\frac{1}{25}\right)^2 \cdot (0{,}04R_2)^2 + \left(\frac{16}{25}\right)^2 \cdot (0{,}01 \cdot R_2)^2} = \sqrt{\frac{1}{25^2} \cdot 0{,}00016R_2^2 + \frac{256}{25^2} \cdot 0{,}0001R_2^2}$

$u(R_{EKV}) = \sqrt{\frac{R_2^2}{25^2}(0{,}00016 + 0{,}0256)} = \frac{R_2}{25} \cdot \sqrt{0{,}0272} = \frac{\sqrt{0{,}0272}}{25} \cdot R_2$

$\frac{u(R_{EKV})}{R_{EKV}} = \frac{\frac{\sqrt{0{,}0272}}{25} \cdot R_2}{\frac{4}{5} \cdot R_2} = \frac{\sqrt{0{,}0272}}{20} = 0{,}008246$

$\Rightarrow \frac{u(R_{EKV})}{R_{EKV}} \cdot 100\% = 0{,}8246\%$

$\Rightarrow \frac{u(R_{EKV})}{R_{EKV}} \cdot 100\% = 0{,}82\%$