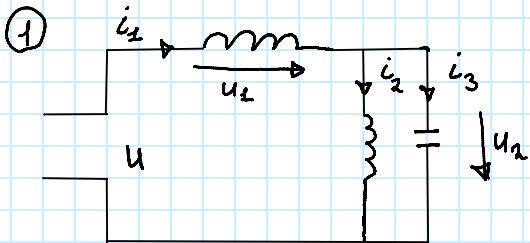


ЛР лист 1

17 октября 2025 г. 17:52

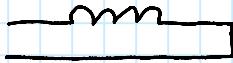


$$1) U_1 = 0 \text{ В}$$

$$U_1 = 4,1 \text{ В}$$

$$I_1 = 12,2 \text{ мА}$$

$$\varphi_1 = 15^\circ$$



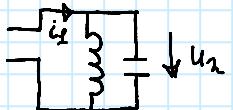
$$\underline{Z}_L = \frac{U_1}{I_1} \cdot e^{j\varphi_1} = \frac{4,1}{0,122} e^{j15^\circ} = 33,6 e^{j15^\circ} = 32,46 + j8,69$$

$$2) U_1 = 0 \text{ В}$$

$$U_2 = 4,2 \text{ В}$$

$$I_1 = 84 \text{ мА}$$

$$\varphi_{21} = -34^\circ$$



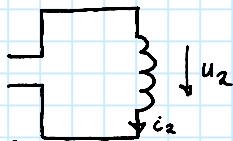
$$\underline{Z}_{21} = \frac{U_2}{I_1} e^{j\varphi_{21}} = \frac{4,2}{0,084} e^{j(-34^\circ)} = 50 e^{j(-34^\circ)} = 41,45 - j27,96$$

$$3) I_3 = 0 \text{ А}$$

$$U_2 = 4,2 \text{ В}$$

$$I_2 = 62 \text{ мА}$$

$$\varphi_2 = 10^\circ$$



$$R_2 = Z_2 \cdot \cos \varphi_2 = 66,74 \Omega$$

$$X_2 = Z_2 \cdot \sin \varphi_2 = 11,76 \Omega$$

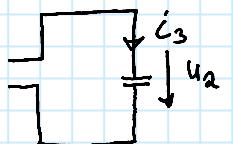
$$\underline{Z}_2 = \frac{U_2}{I_2} \cdot e^{j\varphi_2} = \frac{4,2}{0,062} \cdot e^{j10^\circ} = 67,74 e^{j10^\circ} = 66,71 + j11,76$$

$$4) I_2 = 0 \text{ А}$$

$$U_2 = 4,2 \text{ В}$$

$$I_3 = 61 \text{ мА}$$

$$\varphi_{23} = -81^\circ$$



$$\underline{Z}_3 = \frac{U_2}{I_3} \cdot e^{j\varphi_{23}} = \frac{4,2}{0,061} \cdot e^{j(-81^\circ)} = 68,85 e^{j(-81^\circ)} = 10,77 - j68$$

②

$$U_2 = U_2 e^{j0^\circ} = U_2 = 5,41 \text{ В}$$

$$I_2 = \frac{U_2}{Z_2} = \frac{5,41}{67,74 e^{j0^\circ}} = 79,9 e^{j(-10^\circ)} \text{ мА}$$

$$I_1 = \frac{U_2}{Z_1} = \frac{5,41}{68,85 e^{j(-81^\circ)}} = 78,58 e^{j81^\circ} \text{ мА}$$

$$I_1 = \frac{U_2}{Z_{23}} = \frac{5,41}{50 e^{j(-34^\circ)}} = 108,2 e^{j34^\circ} \text{ мА}$$

$$U_1 = I_1 \cdot Z_1 = 108,2 e^{j34^\circ} \cdot 10^{-3} \cdot 33,6 \cdot e^{j15^\circ} = 3,64 e^{j49^\circ} \text{ В}$$

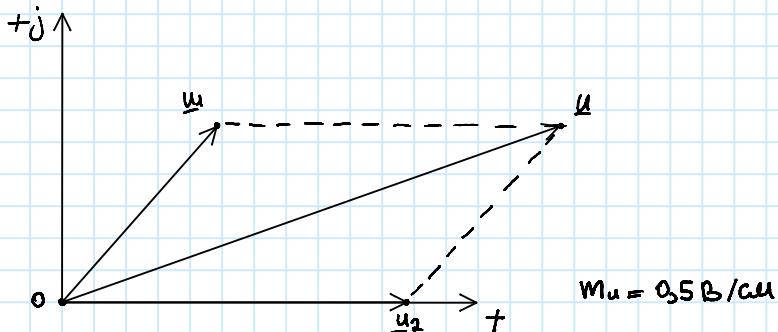
$$Z_{\text{раб}} = Z_1 + Z_{23} = 33,6 e^{j15^\circ} + 50 e^{j(-34^\circ)} \Omega$$

$$U = I_1 \cdot Z_{\text{раб}} = 108,2 e^{j34^\circ} \cdot 10^{-3} \cdot (33,6 e^{j15^\circ} + 50 e^{j(-34^\circ)}) = 3,6352 e^{j49^\circ} + 5,41 e^{j(0)} = 3,64 e^{j49^\circ} + 5,41 \text{ В}$$

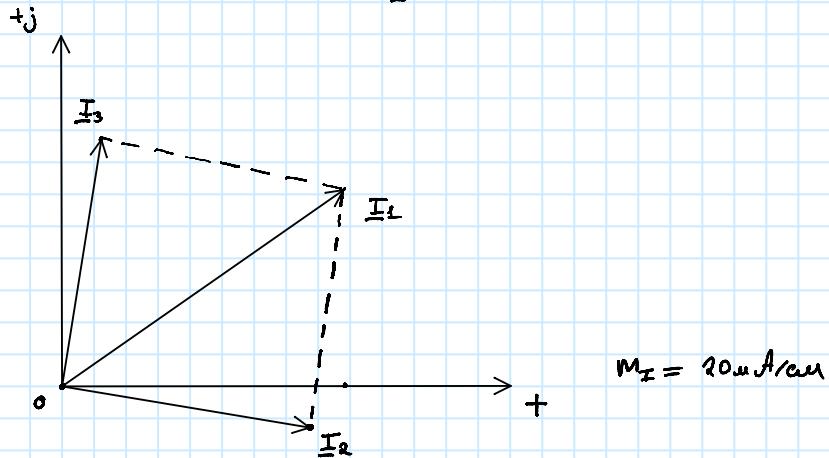
ЛР Лист 2

17 октября 2025 г. 19:34

③ Векторные диаграммы



$$M_u = 0,5 \text{ В/ам}$$



$$M_I = 20 \text{ мА/ам}$$

④

$$\underline{U} = \underline{U}_1 + \underline{U}_2 = 3,64 e^{j49} + 5,41 \text{ В}$$

$$\underline{I}_1 = \underline{I}_2 + \underline{I}_3 = 79,9 e^{j(-10)} + 78,58 e^{j81} = 110,92 e^{j35}$$

⑤

$$\sum \underline{S}_u = \sum \underline{S}_n$$

$$\underline{S}_u = 4 \underline{I}_1 e^{j\theta} = 4 I_1 \cos \varphi \pm j 4 I_1 \sin \varphi = 8,4 \cdot 112 \cdot 10^3 \cos(-13^\circ) +$$

$$+ j 8,4 \cdot 112 \cdot 10^3 \sin(-13^\circ) = 9,92 - j 0,21 \text{ Вт}$$

$$\frac{\underline{S}_u}{R} = \frac{P_u \pm j Q_u}{R} = \frac{S_n}{R} \pm j \frac{Q_n}{R}$$

$$\frac{S_n}{R} = I_1^2 R_1 + I_2^2 R_2 + I_3^2 R_3 = 0,112^2 \cdot 39,46 + 0,081^2 \cdot 80,71 + 0,074^2 \cdot 10,77 = 0,9 \text{ Вт}$$

$$Q_n = I_1^2 X_1 + I_2^2 X_2 + I_3^2 X_3 = 0,112^2 \cdot 8,69 + 0,081^2 \cdot 11,76 + 0,074^2 \cdot (-68) = -0,19 \text{ Вт}$$

$$S_n = 0,9 - j 0,19 \approx 0,92 - j 0,21 = S_u$$