Laboratory work 3.40

Determining the capacitance of the capacitor bridge of SOTI

Appliances and accessories: 1) sets of capacitors with unknown and known capacities; 2) the store of resistors; 3) electronic indicator of zero (EIZ).

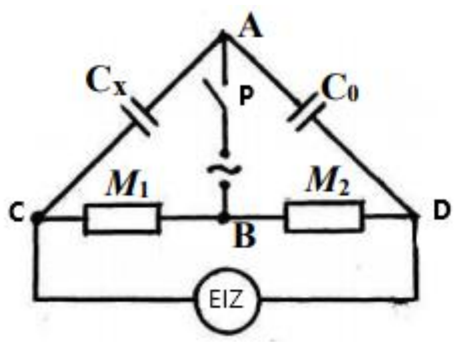
Destination of this work: determining the capacity of the capacitor by bridge of SOTI.

Description the appliance and theoretical statement:

Capacity (capacitance) is a physical quantity, numerically equal to charge, which must be in conductor that its potential was raised per unit.

To obtain a large capacity use capacitors that they are as two strip conductors separated by a thin dielectric layer.

In practice, the capacity of the capacitor can be determined by the bridge like as to the bridge to determine the resistance by replacing in the scheme known and unknown resistors and similar to the known capacity C_0 and measured C_x capacities (pic.1).



Pic. 1

To the points A and B supplied alternative voltage (6.3 V) and to the points D and C

Connect electronic indicator of zero (oscilloscope). If you change the resistances R_1 and R_2 in the stores of resistors M1 and M2, the voltage at the CD change and can be minimized. The zero indicator allows you to directly notice the appearance of the minimum voltage at the CD.

When you turn on or turn off the apparatus alternating current will flow through

areas of circles ACB and ADB.

You need to choose the resistance R_1 and R_2 that the potential difference on entrance of indicator become minimal. This means that the potentials of points D and C must be almost same:

$$\varphi_C \approx \varphi_D$$

(1)

To this condition, the values of currents at the AC and the CB, and also at the AD and DB must be the same:

$$I_{c_x} = I_1 \qquad I_{c_0} = I_2$$

(2)

Using Ohm's law for AC parts of the circuit only resistive or only capacitive resistance $\left(R = \frac{1}{\omega C}\right)$ and according to the equation (2) , we can write:

$$\frac{\varphi_A - \varphi_C}{\frac{1}{\omega C_x}} = \frac{\varphi_B - \varphi_C}{R_1},$$

(3) $$\frac{\varphi_A - \varphi_D}{\frac{1}{\omega C_0}} = \frac{\varphi_B - \varphi_D}{R_2},$$

(4)

$$C_x = C_0 \frac{R_2}{R_1}$$

where $\varphi_A, \varphi_B, \varphi_C$ and φ_D are potentials of the points A, B, C, D;

ω is the cyclic frequency of the alternating current.

From equations (3), (4) and (1) we get:

(5)

The sequence of measurements

1. Connecting the apparatus to the network.

2. Put known capacity C_0 and resistance R_1 and pick up in the store of resistors M_2 that resistors R_2 that the amplitude of the signal on the oscilloscope screen was minimal.

3. Changing R_1 to repeat the experiment twice more. According to the formula (5) to calculate

the capacity of the unknown capacitor C_x.

4. To repeat with a different capacitor by the above measurements.

5. To measure the battery capacity $\langle C_1 \rangle$ of capacitors $\langle C_2 \rangle$ (in parallel $C_{consec.}$ and consecutive $C_{parallel}$ connection of capacitors).

6. The results of measurements and calculations to write to the table.

7. The final result is written in the form:

8.According to average value and measure and .

$$C^{theor.}_{paral.} = \langle C_1 \rangle + \langle C_2 \rangle; \; C^{theor.}_{cons.} = \frac{\langle C_1 \rangle \cdot \langle C_2 \rangle}{\langle C_1 \rangle + \langle C_2 \rangle} \quad (6)$$

and compare them with the measured one.

Table

№ measurem.	studied conductor	$C_{0.}$ mcF	R_1, ohm	R_2, ohm	C_{x_i} mcF	$\langle C \rangle$, mcF	ΔC_{x_i}, mcF	$\Delta C^2_{x_i}$, $(mcF)^2$	$S\langle C \rangle$, mcF	$\Delta\langle C \rangle$, mcF	E, %
1	1										
2											
3											
1	2										
2											
3											
1	consequence connection										
2											
3											
1	parallel connection										
2											
3											

$C_1 = \left(\langle C_1 \rangle \pm \Delta C \right)$ *mcF where* $\alpha =$

$C_2 = \left(\langle C_2 \rangle \pm \Delta C \right)$ *mcF where* $\alpha =$