ISTANBUL COMMERCE UNIVERSITY

Electrical-Electronics Engineering
EEE202 Electro-technic Laboratory

Theory

Part 7

Contents

PARALLEL CIRCUITS IN AC

7.1 EXAMINATION OF RL PARALLEL AC CIRCUIT

In figure 7.1, the AC circuit formed by the parallel connection of resistor and inductor is shown.

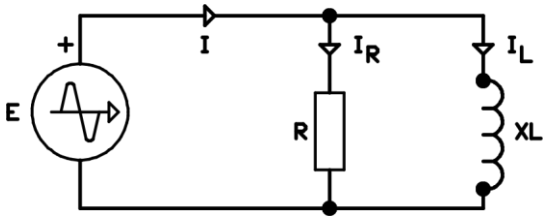

Figure 7.1

In figure, there is circuit voltage on the terminals of resistor and inductor. Current passes through the resistor depending on resistors value and it passes through the inductor depending on inductor's inductive reactance. Circuit current is the vectorial sum of currents passing through resistor and inductor.

The current passing through the resistor is in the same phase with circuit voltage. The current passing through the inductor is 90^0 behind the circuit voltage. In order to draw the phasor diagram of such a circuit, first the voltage as reference variable should be taken to the positive field of the horizontal axis. Then the other variables will be positioned depending on the reference

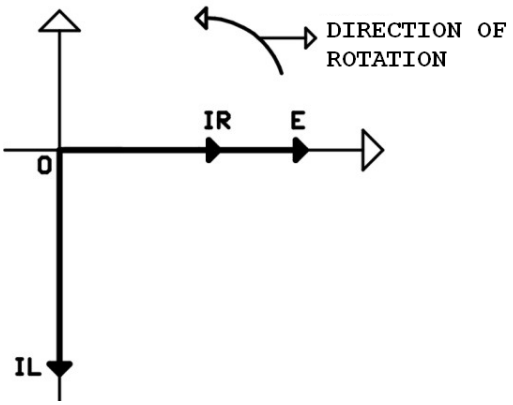

Figure 7.2

After drawing the phasor diagram, circuit current is calculated by the help of Pythagorean Theorem:

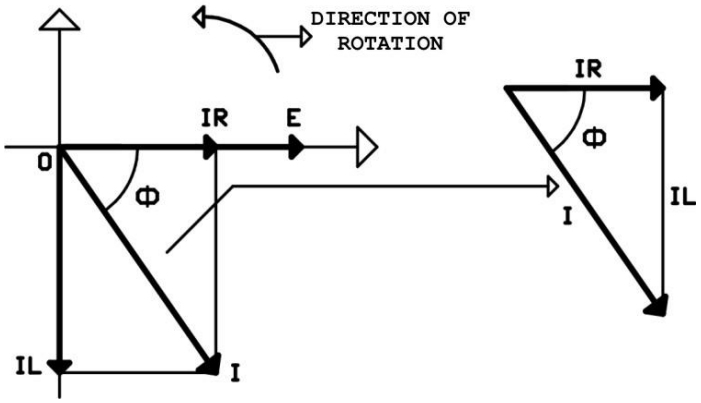

Figure 7.3

$$I^2 = IR^2 + IL^2$$
$$I = \sqrt{IR^2 + IL^2}$$

Conductance, admittance, susceptance triangle can be drawn by dividing circuit current equation by the square of circuit voltage.

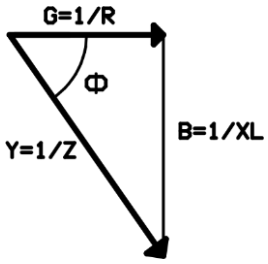

Figure 7.4

This triangle is called "YGB" triangle.

$$\frac{I^2}{E^2} = \frac{IR^2}{E^2} + \frac{IL^2}{E^2}$$
$$Y^2 = G^2 + B^2$$

In Formula;

Y- Admittance of circuit
G- Conductance of resistor
B- Susceptance of inductor

In YGB triangle, circuit impedance can be written such as the parallelly connected resistors.

$$\frac{1}{Z^2} = \frac{1}{R^2} + \frac{1}{XL^2}$$

The easy way in calculating circuit impedance is to divide the circuit voltage by circuit current.

$$Z = \frac{E}{I}$$

Power coefficient of the circuit (**cosΦ**) is calculated by law of cosines.

$$Cos\phi = \frac{IR}{I}$$

Phase angle of the circuit is the one which is the cosine of power coefficient. Phase angle is found by looking at the trigonometric scale.

The active power dissipated by circuit;

$$P = E.I.Cos\phi$$

Practically, the known values in AC circuits are circuit voltage, circuit current and the values of the components. The demanded values are respectively reactances of components, leg currents, circuit current, circuit impedance, power factor, circuit phase angle and the power dissipated by the circuit. Solution should be made on this order.

NOTE: If there is an inductor in serially connected AC circuits, internal resistance of the inductor presents opposition to current just as a real resistance. For this reason, internal resistance of the inductor was added to the real resistance in the experiments of serial AC circuits that include inductor.

In parallel connected AC circuits, the leg which the inductor is connected is actually formed by the serial connection of inductor and internal resistance of inductor. In order to prevent the mathematical operations to be too complex, <u>inductor's resistance is omitted</u> in our parallel AC experiments.

7.2 EXAMINATION OF RC PARALLEL AC CIRCUIT

In figure 7.5, the AC circuit formed by the parallel connection of resistor and capacitor is shown.

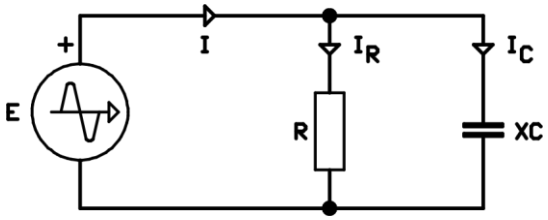

Figure 7.5

In figure, there is circuit voltage on the terminals of resistor and capacitor. Current passes through the resistor depending on resistors value and it passes through the capacitor depending on capacitor's capacitive reactance. Circuit current is the vectorial sum of currents passing through resistor and capacitor.

The current passing through the resistor is in the same phase with circuit voltage. The current passing through the capacitor is 90^0 ahead of the circuit voltage. In order to draw the phasor diagram of such a circuit, first the voltage as reference variable should be taken to the positive field of the horizontal axis. Then the other variables will be positioned depending on the reference

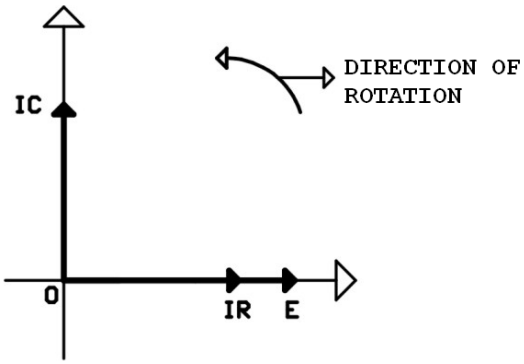

Figure 7.6

Circuit current is calculated by the help of Pythagorean Theorem:

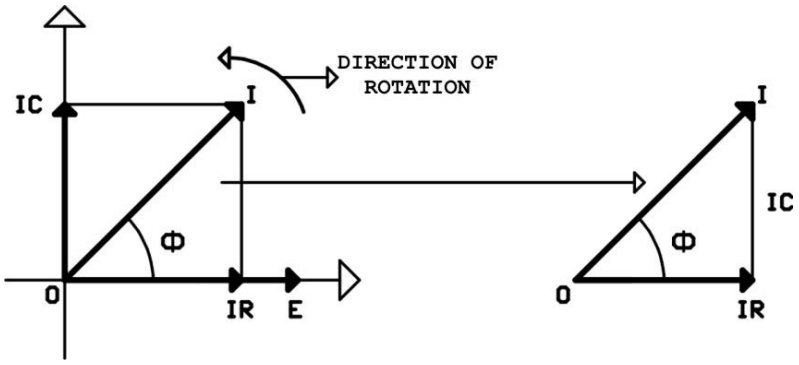

Figure 7.7

$$I^2 = IR^2 + IC^2$$
$$I = \sqrt{IR^2 + IC^2}$$

The way of calculating circuit impedance is to divide circuit voltage by circuit current.

$$Z = \frac{E}{I}$$

Power coefficient of the circuit (**cosΦ**) is calculated by law of cosines.

$$Cos\phi = \frac{IR}{I}$$

Phase angle of the circuit is the one which is the cosine of power coefficient. Phase angle is found by looking at the trigonometric scale.

The active power dissipated by circuit;

$$P = E.I.Cos\phi$$