BEEE101L – Basic Electrical Engineering

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Module 2 : AC Circuits 6 Hrs

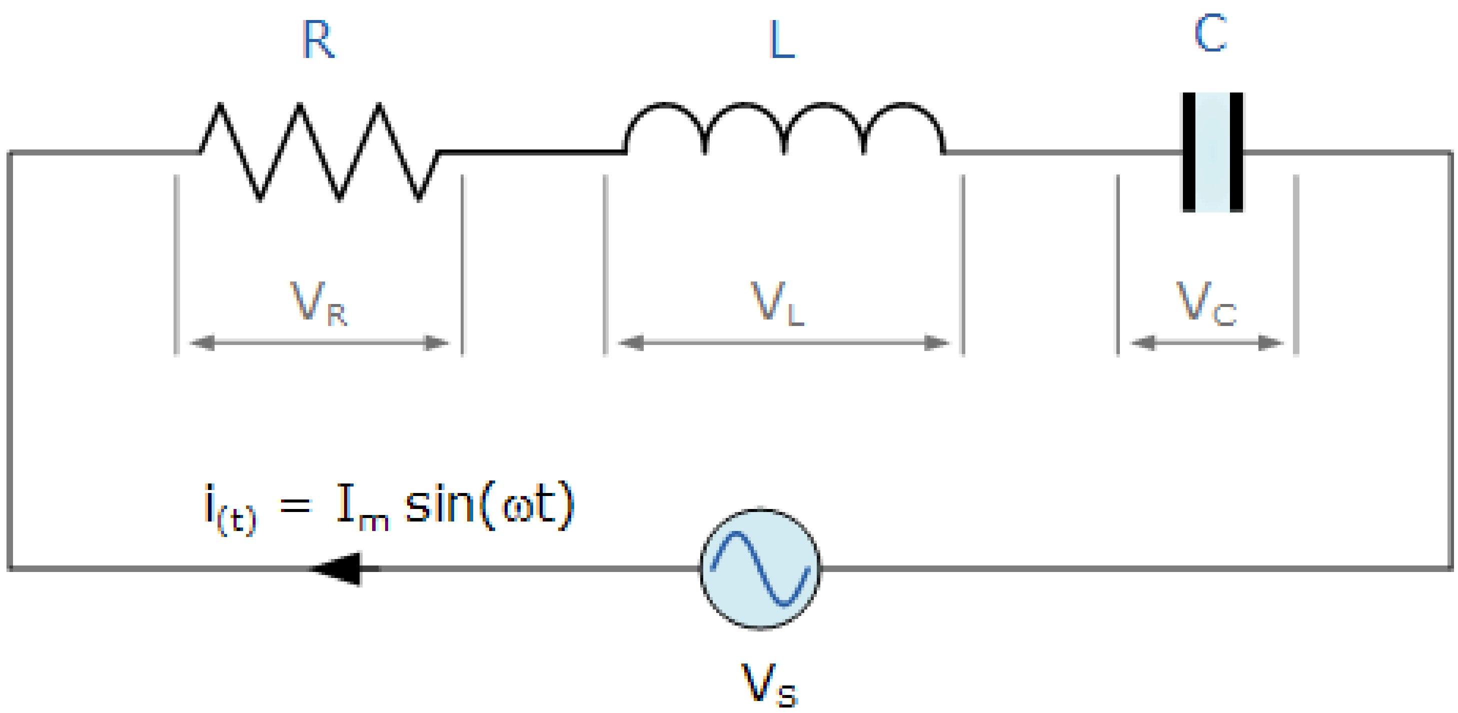
Alternating voltages and currents, RMS, average, form factor, peak factor; Single phase RL, RC, RLC series and parallel circuits; Power and power factor; Balanced three phase systems

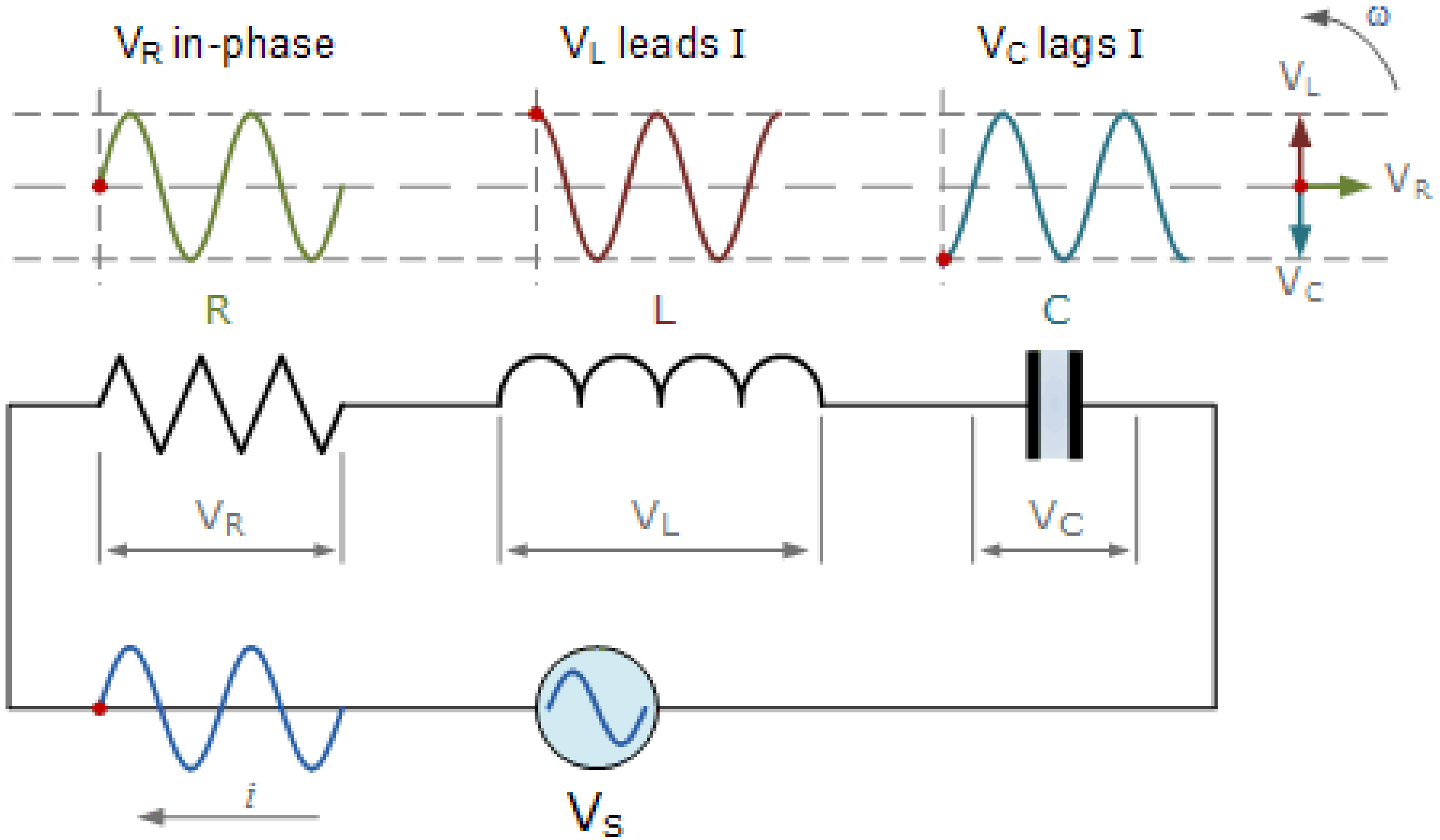
Course Outcome

- Evaluate AC circuit parameters using laws

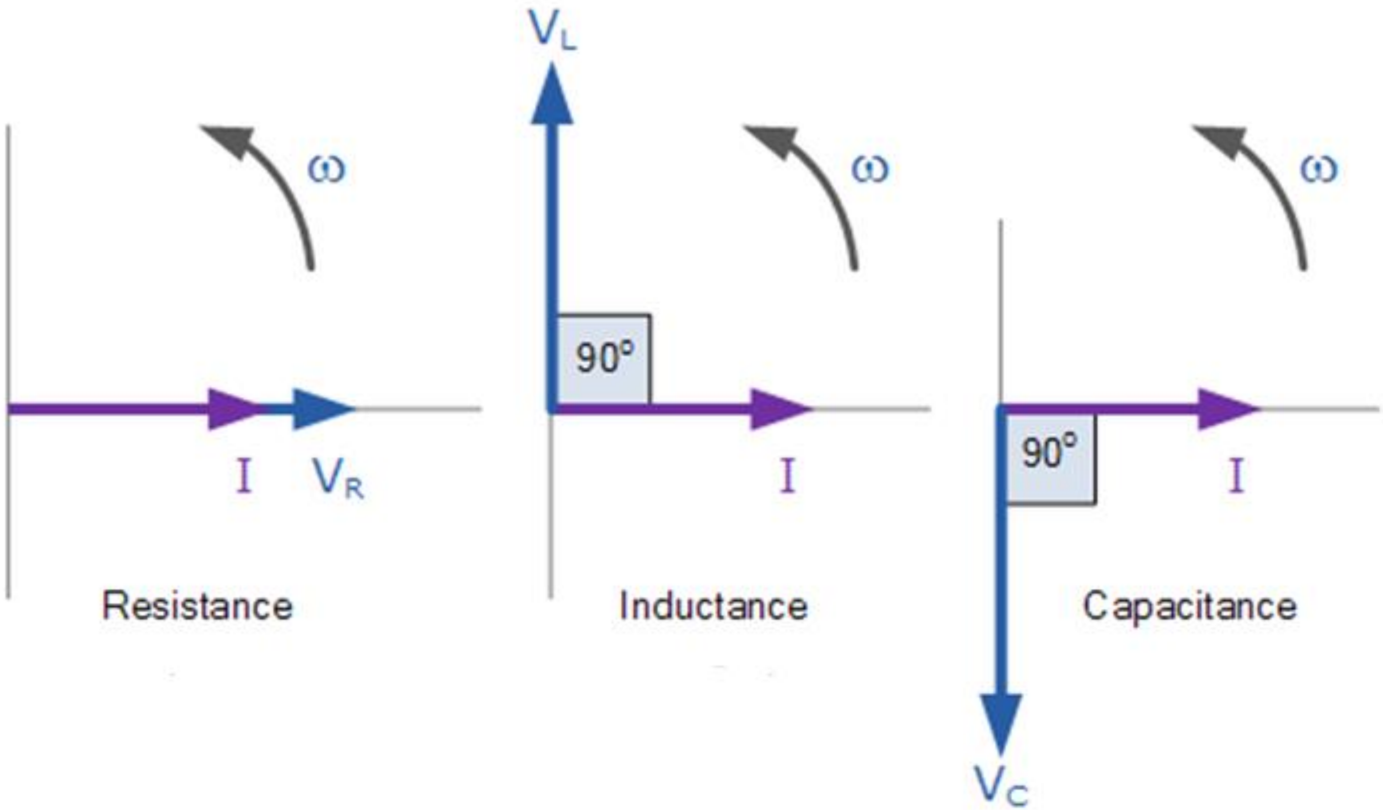
RLC series circuit

Series RLC Circuit



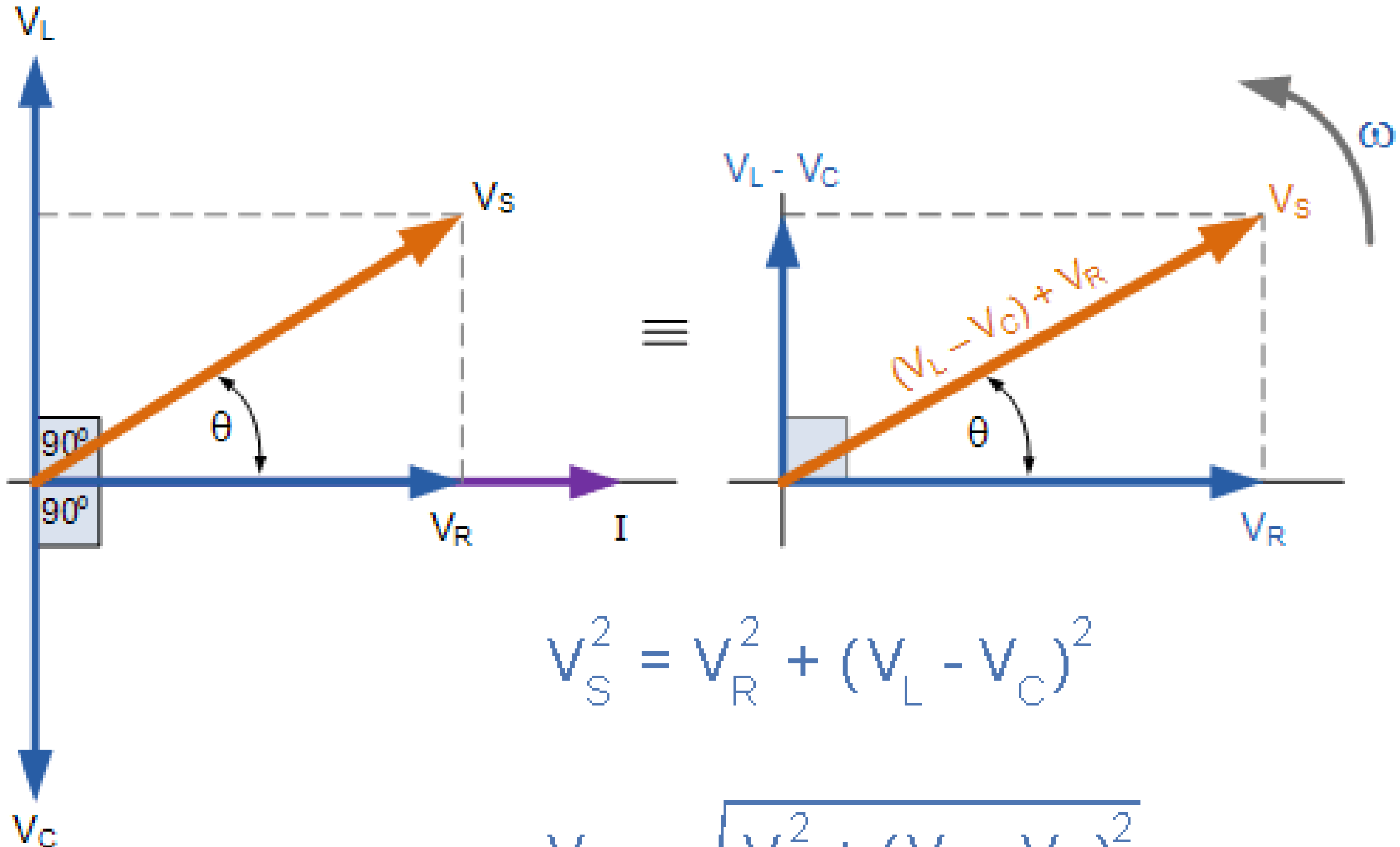

V_R in-phase
V_L leads I
V_C lags I
ω
V_L
V_R
V_C
R
L
C
V_R
V_L
V_C
i
V_S

Individual Voltage Vectors



Case (i) $V_L > V_c$

Phasor Diagram for a Series RLC Circuit



$$V_S^2 = V_R^2 + (V_L - V_C)^2$$

$$V_S = \sqrt{V_R^2 + (V_L - V_C)^2}$$

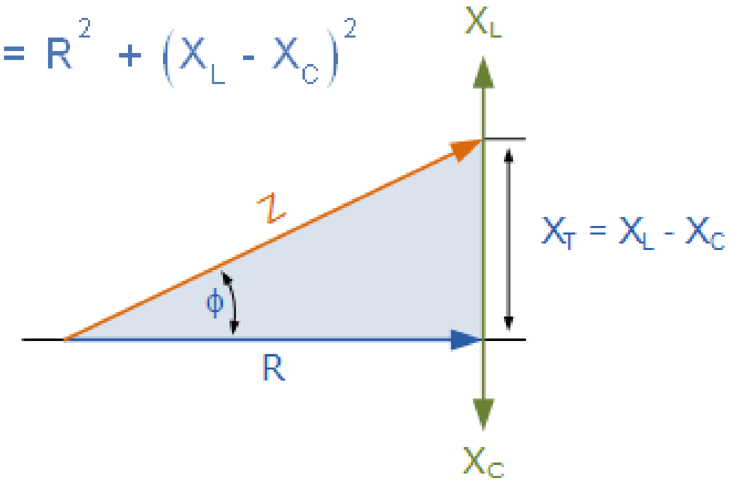
$$V_R = I.R \qquad V_L = jI.X_L \qquad V_C = -jI.X_C$$

$$V_S = \sqrt{(I.R)^2 + (I.X_L - I.X_C)^2}$$

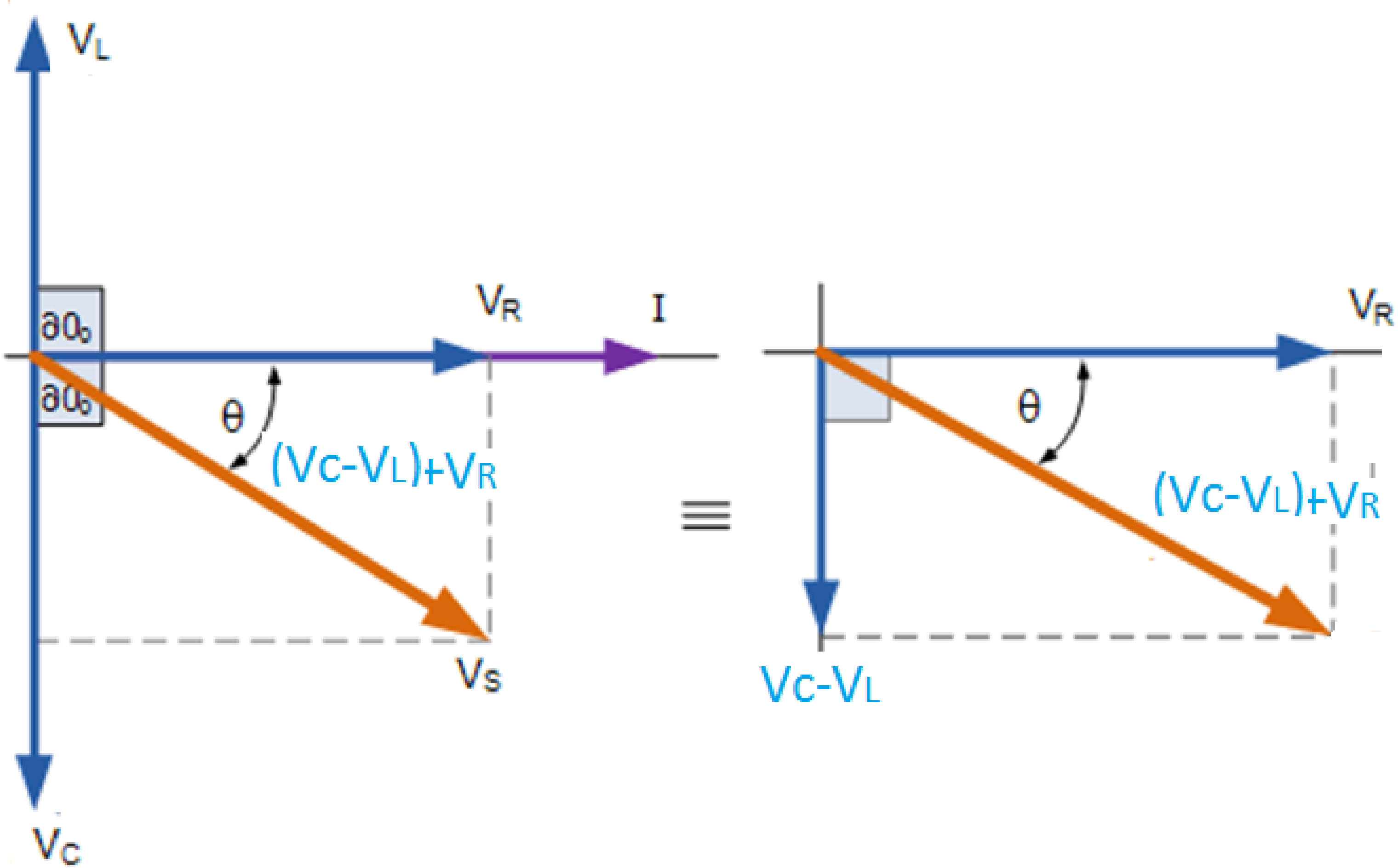
$$V_S = I.\sqrt{R^2 + (X_L - X_C)^2}$$

$$\therefore V_S = I \times Z \qquad \text{where: } Z = \sqrt{R^2 + \left(X_L - X_C\right)^2}$$

$$Z^2 = R^2 + \left(X_L - X_C\right)^2$$



Case (ii) $V_C > V_L$



$$V_R = I.R \qquad V_L = jI.X_L \qquad V_C = -jI.X_C$$

$$V_S = \sqrt{(I.R)^2 + (I.X_C - I.X_L)^2}$$

$$V_S = I.\sqrt{R^2 + (X_C - X_L)^2}$$

$$\therefore V_S = I \times Z \qquad \text{where: } Z = \sqrt{R^2 + (X_C - X_L)^2}$$

Problems

An inductive coil takes 10 A and dissipates 1000 W when connected to a supply at 250 V, 25 Hz. Calculate the effective resistance, reactance, impedance and the power factor

$$Z = V/I = \frac{250}{25} = 10\ \Omega$$

$P = 1000$ W (given)

$$S = VI = 250 \times 25 = 1250\ W$$

Refer class notes

Problems

When a voltage of 100 V at 50 Hz is applied to a choking coil A, the current taken is 8 A and the power is 120 W. When applied to a coil B, the current is 10 A and the power is 500 W. What current and power will be taken when 100 V is applied to the two coils connected in series.

Refer class notes

Problems

A resistance of 100 Ω is connected in series with a 50 μF capacitor across 200 V, 50 Hz supply. Calculate

(i) impedance, current, power factor and phase angle

(ii) draw the phasor diagram

Refer class notes

Problems

Find the circuit constants of a two element series circuit which consumes 700 W with 0.707 leading power factor. The applied voltage is $\upsilon=141.4 \sin 314t$

Refer class notes